WELCOME TO TECHNICAL ORDER 00-105E-9.

THIS IS SEGMENT 10 COVERING CHAPTER 17.

IF YOU WOULD LIKE TO GO DIRECTLY TO THE TECHNICAL ORDER, CLICK ON THE CONTINUE BUTTON.

TO SEE THE SEGMENT INFORMATION CHANGE NOTICE, CLICK ON THE NOTICE BUTTON.

CONTINUE

NOTICE

CONTACT

IF YOU NEED TO CONTACT THE TECHNICAL CONTENT MANAGER FOR THIS TECHNICAL ORDER, CLICK ON THE CONTACT BUTTON.

TECHNICAL ORDER 00-105E-9 TECHNICAL CONTENT MANAGER

WRITTEN CORRESPONDENCE:

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http://www.afcesa.af.mil/Directorate/CEX/Fire/default.html

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DSN 523-6150

FAX: (850) 283-6390
DSN 523-6390

For technical order improvements, correcting procedures, and other inquiries, please use the above media most convenient.

SEGMENT 10 INFORMATION CHANGE NOTICE

This page is provided to notifiy the user of any informational changes made to Technical Order 00-105E-9 in this Segment and the current Revision. Informational changes will be referenced in the Adobe Reader's Bookmark tool as a designator symbol illustrated as a <[C]> for quick reference to the right of the affected aircraft. The user shall insure the most current information contained in this TO is used for his operation. Retaining out of date rescue information can negatively affect the user's operability and outcome of emergencies. If the user prints out pages his unit requires, the user shall print the affected page(s), remove and destroy the existing page(s), and insert the newly printed page(s) in the binder provided for that purpose. A Master of this TO shall be retained in the unit's library for reference, future printing requirements and inspections.

CHAPTER	AIRCRAFT	PAGE	EXPLANATION OF CHANGE
NOTE: All chapters from this point have been renumbered.			
17	Orbiter Vehicle	ALL	New chapter designation.
17	Orbiter Carrier	ALL	New chapter designation.

NOTE

Chapter 17 contains emergency rescue and mishap response information for the following aircraft:

NASA	**ORBITER VEHICLE**
NASA	**ORBITER CARRIER**

CHAPTER 17

NASA

AEROSPACE EMERGENCY RESCUE AND MISHAP RESPONSE INFORMATION

17-1. INTRODUCTION AND USE.

17-2. This section contains emergency rescue and mishap response information illustrations in alpha-numerical order relative to type and model of aircraft. This arrangement of illustrations is maintained from Chapter 4 throughout the remainder of the publication.

17-3. GENERAL ARRANGEMENT.

17-4. Aircraft type designation has been positioned in the upper right corner of the horizontal illustration for rapid identification. Additional aids to rapid orientation are:

a. Recent technological advances in aviation have caused concern for the modern firefighter. Aircraft hazards, cabin configurations, airframe materials, and any other information that would be helpful in fighting fires, the locating and rescue of personnel will be added as the information becomes available.

b. Suggested special tools/equipment are listed in the upper left corner, on the Aircraft/Entry page of each listed aircraft.

c. Procedural steps covering emergency/normal entrances, cut-ins, engine/APU shutdown, safetying ejection/escape systems, and aircrew extraction are outlined on the left side of each page with coordinated illustrations on the right.

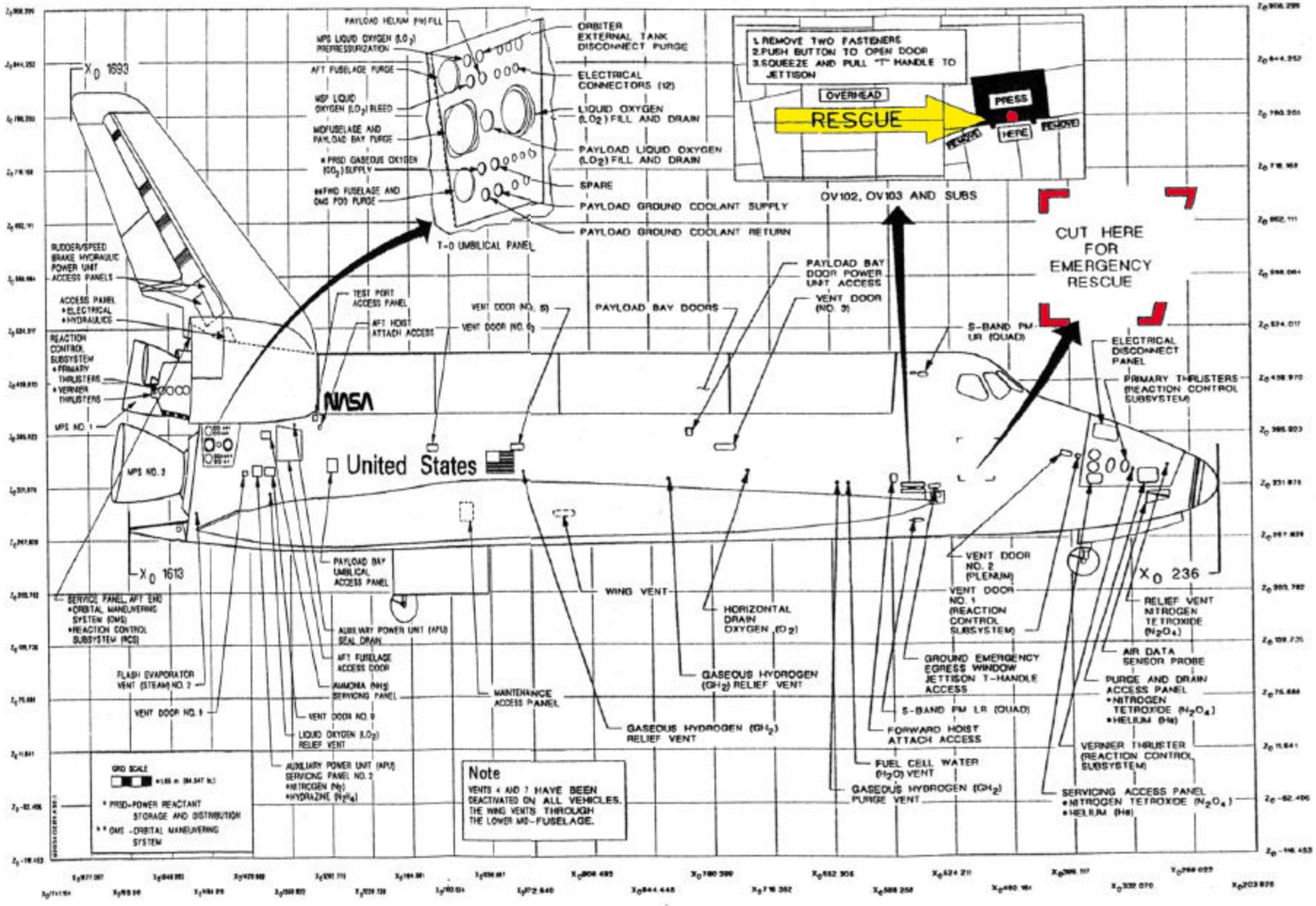
d. Illustrations located on right side of pages are coordinated with text by numerals and small letters depicting both paragraph and subparagraph on the page.

e. Each illustration is consistently colored and/or pattern keyed to highlight essential emergency rescue information.

f. Details are pulled directly from the illustration to highlight an area, thus eliminating unnecessary searching for desired information.

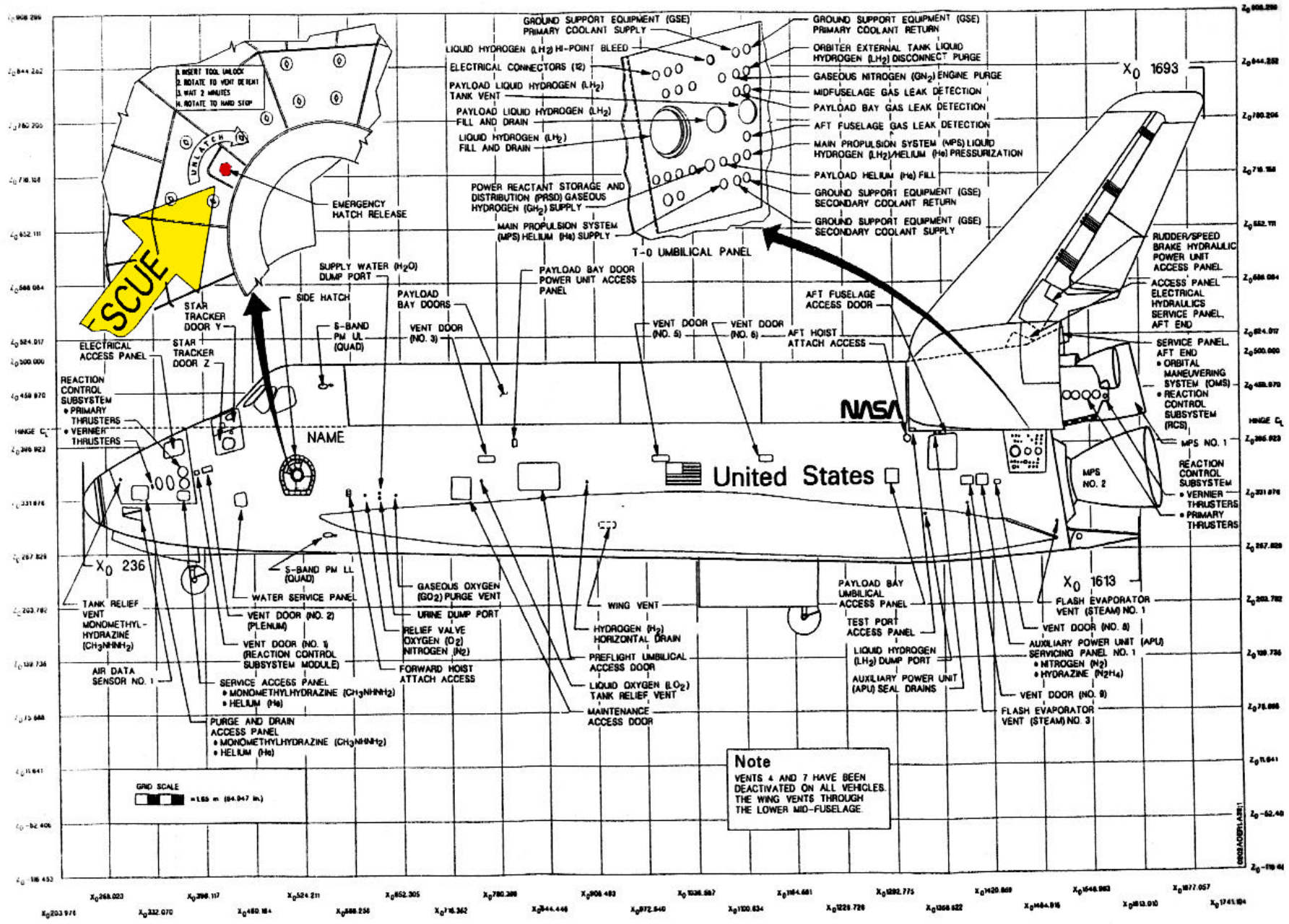
SKIN PENETRATION POINTS

NOTE:
OV = ORBITER VEHICLE



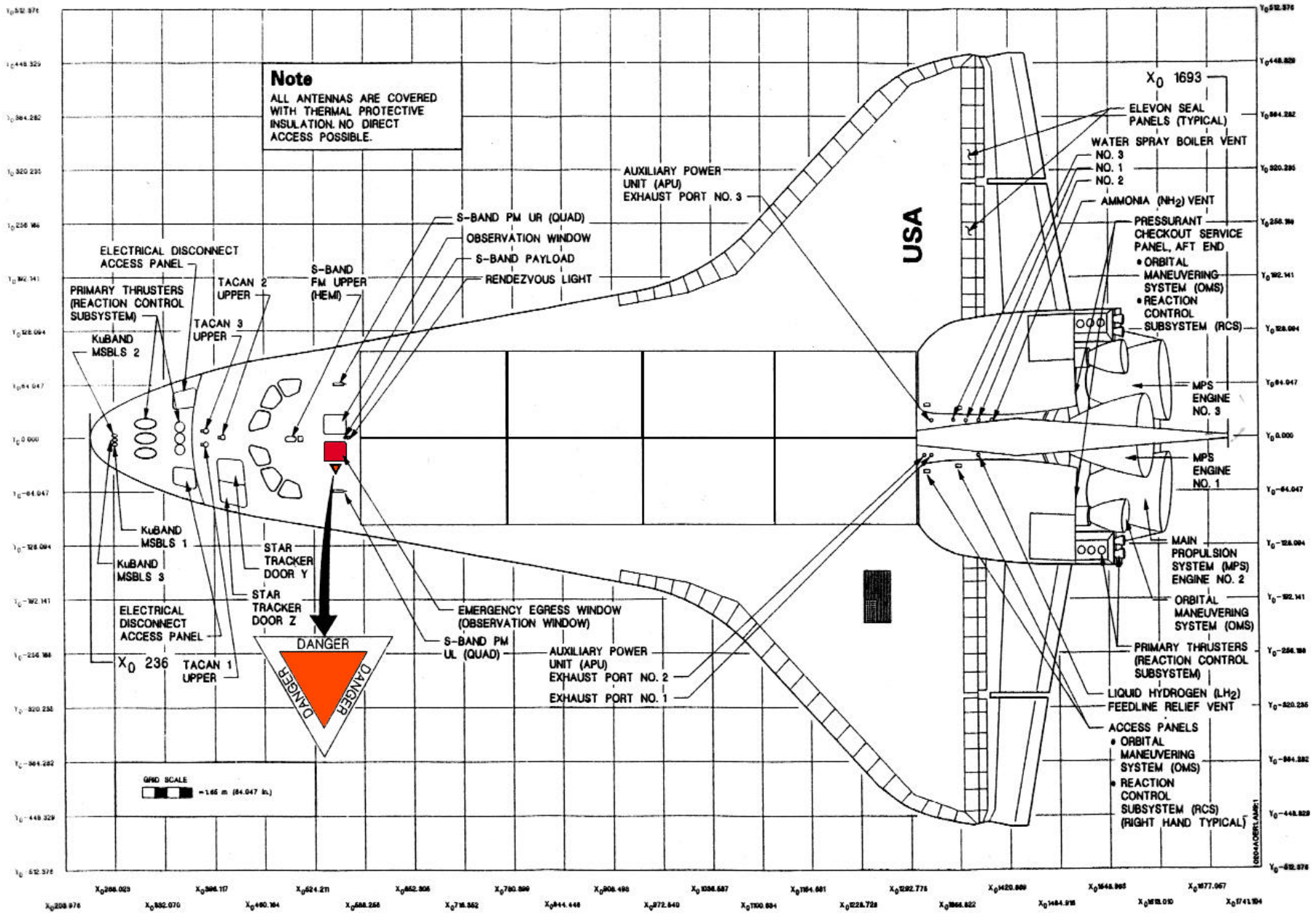
RIGHT SIDE

SKIN PENETRATION POINTS-Continued



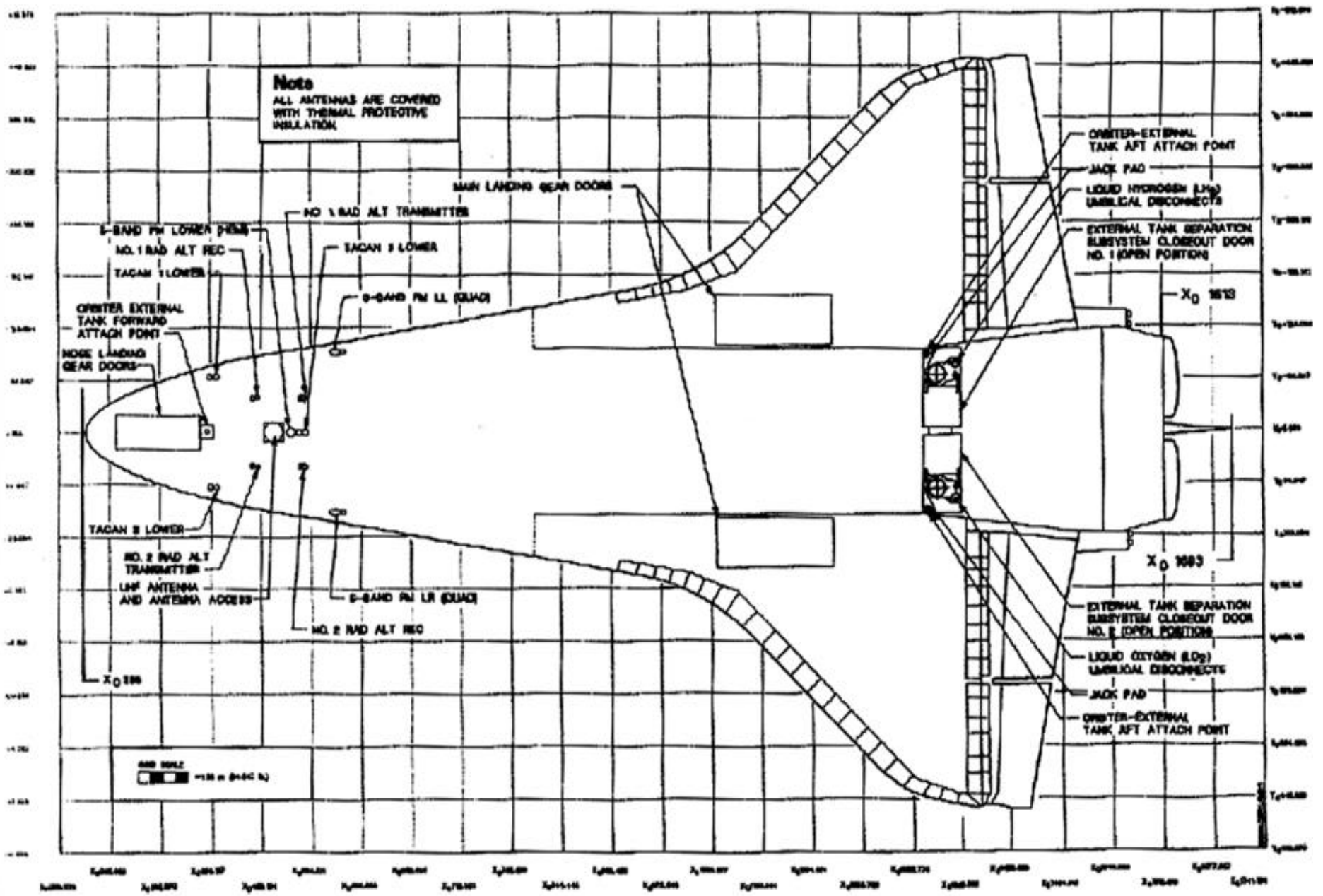
LEFT SIDE

SKIN PENETRATION POINTS-Continued



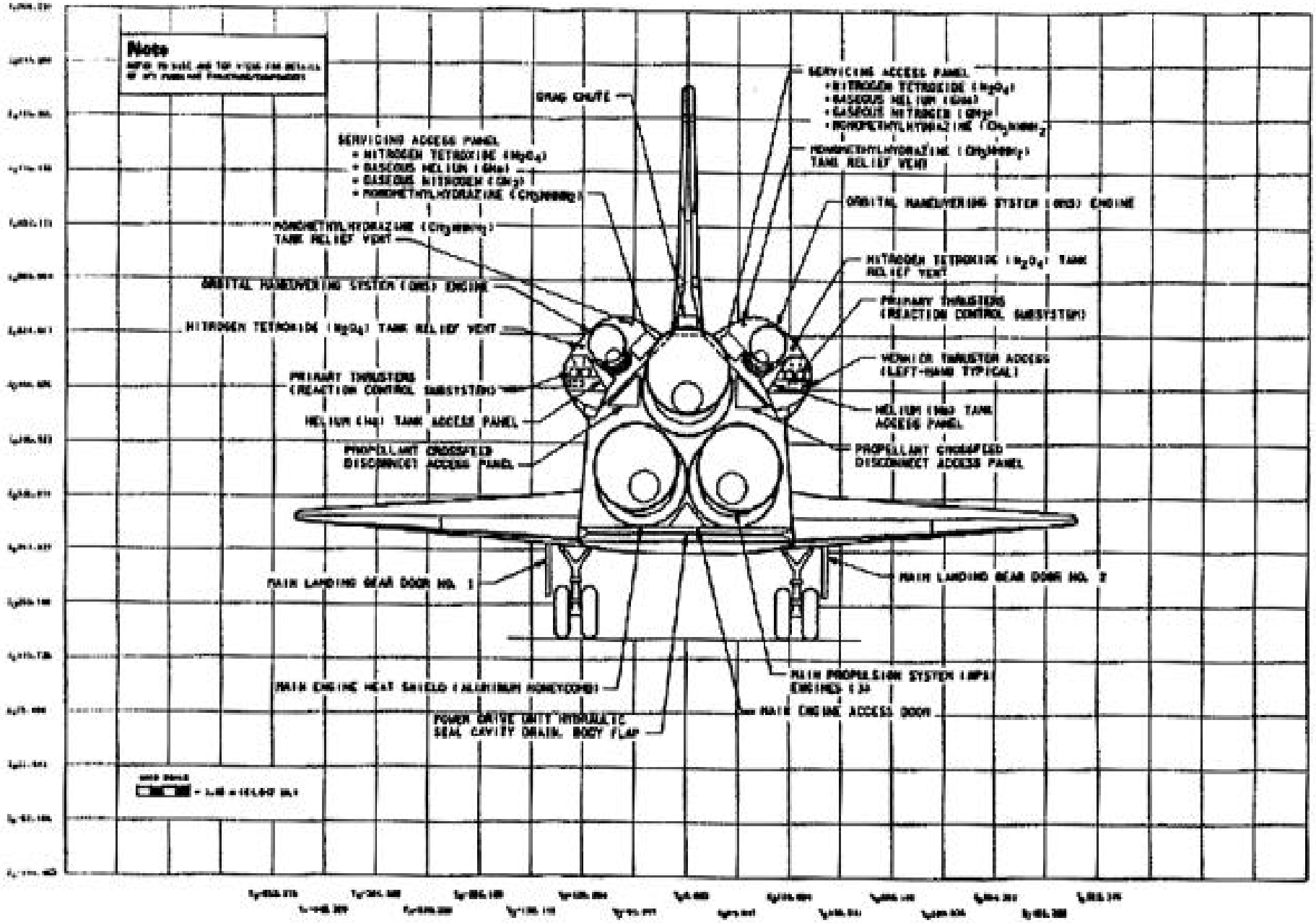
TOP VIEW

SKIN PENETRATION POINTS-Continued



BOTTOM VIEW

SKIN PENETRATION POINTS-Continued



AFT VIEW

TYPES OF HAZARDS AND SAFETY PRECAUTIONS

The types of hazards associated with all fluids and gases onboard the Orbiter and the safety precautions that should be taken with each are addressed here. Potential Orbiter hazards include exposure to gases (ammonia, helium, nitrogen, oxygen), raw propellants (hydrazine, monomethlhydrazine, nitrogen tetroxide, liquid hydrogen, liquid oxygen), and toxic vapors (ammonia. hydrazine, monomethlhydrazine, nitrogen tetroxide). Flash fires, high pressures, hot brakes and wheels, propellant fires, steam/ hot water , and unexpected pyrotechnic devices are elements which contribute to flammability and toxic hazards. Fluid/gas storage tank locations are provided on page OV.15.

Fluid/gas specifications, locations, associated systems, approximate total tank capacities, lower explosive limits (LEL), upper explosive limits (UEL), threshold limit values (TVL), and descriptions are included on pages OV.9 and OV.10.

The ranking officer/supervisor at the landing site will determine the acceptable level of protection to be used by the crash/rescue personnel under his supervision before exposure to any Orbiter hazards. Acceptable levels of protection will be predetermined, based on worst case contingency as specified in program approved safety and health documents, and will not be restricted by the minimal levels described in the manual. This may include additional or higher-rated protective equipment.

Classifications of Hazardous Fluids/Gases

Pages OV.11 through OV.14 classifies Orbiter hazardous fluids/gases into three classifications (toxic, flammable, hypergolic). Toxic substances produce harmful effects on biological systems. In general, the toxicity of a specific substance depends on a number of factors: (1) quantity required to produce harmful effects (2) the rate and extent to which a chemical is absorbed by biological systems (inhalation, ingestion, injection), (3) the rate and extent of chemical breakdown, and (4) the rate and extent of excretion.

In dealing with average, healthy humans, it is useful to quantify the limit to which people may be repeatedly exposed on an all-day, everyday basis without suffering adverse effects. This is known as TLV. It is usually expressed as parts per million (ppm) for gases in air or milligrams per cubic meter $(mg/m)^3$ for fumes and dusts. The lower TLV's, the more toxic the substance. For common substances, TLV's vary from 0.1 ppm to 1000 ppm. The higher the TLV, the less likelihood of harmful effects from similar exposures.

The flammability of a substance is generally defined as the ability to easily ignite and burn. More precise definitions are given in the Code of Federal Regulations (CFR)- Transportation, Title 49, which governs the transport of hazardous materials, and the National Fire Protection Association (NFPA), which generates regulations for the storage and use of hazardous materials.

The hazard associated with these substances is that they ignite quite readily when they are mixed with air or an oxidizer and are exposed to a source of ignition. The minimum concentration of gas or vapor in air below which a substance does not burn when exposed to an ignition source is called the LEL (too lean). The maximum concentration of the substance in air above which ignition does not occur when exposed to an ignition source is called the UEL (too rich). The lower and upper explosive limits are expressed in percent by volume of vapor in air. The flammability range of a substance is the numerical difference between the lower and upper explosive limits.

Orbiter hypergolic propellants (hydrazine, monomethylhydrazine) are self-igniting upon contact with the oxidizer (nitrogen tetroxide) and are considered extremely hazardous.

Onboard Quantities at Landing

Quantities of the hazardous fluids/gases onboard the Orbiters following emergency landings [return to launch site (RTLS), transoceanic abort landing (TAL), abort once around (AOA)] and normal end-of-mission landings are provided on pages OV.16 and OV.17 for worst case landings.

Pyrotechnic Devices

Pyrotechnic devices are used for: (1) landing gear release, (2) crew compartment fire suppression, (3) emergency egress window jettison, (4) remote manipulator arm emergency jettison, (5) Ku-band antenna emergency jettison, (6) crew module emergency depressurization, (7) side hatch jettison, (8) Orbiter/external tank separation and (9) drag chute deployment and jettison. Pyrotechnic devices are normally safed by NASA or U.S. Air Force contractor personnel, but crash/rescue personnel should be familiar with their locations, exterior markings, access panels and component locations.

SPACECRAFT DIMENSIONS, WEIGHT, & CLEARANCES

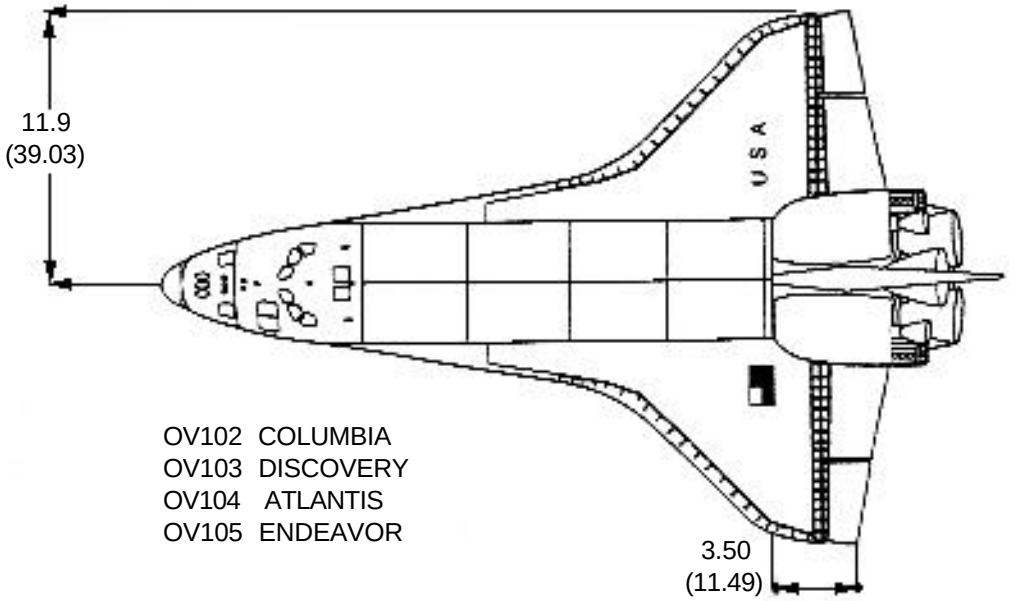
*DIMENSIONS IN METERS (FEET)

DIMENSIONS AND WEIGHT

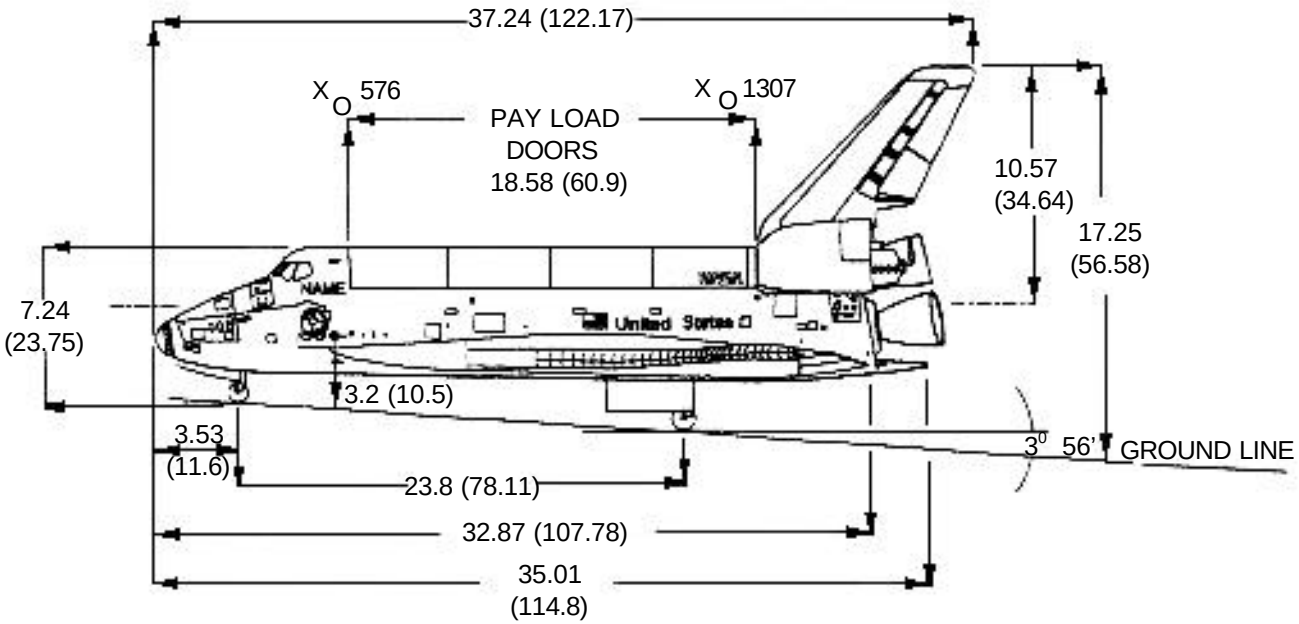
WING SPAN	23.79 m	(78.06 ft)
LENGTH	37.24 m	(122.17ft)
HEIGHT	17.25 m	(56.58 ft)
TREAD WIDTH	6.91 m	(22.67 ft)
GROSS TAKEOFF WEIGHT		VARIABLE
GROSS LANDING WEIGHT		VARIABLE
INERT WEIGHT (APPROX.)	74 844 kg	(165000 lb)

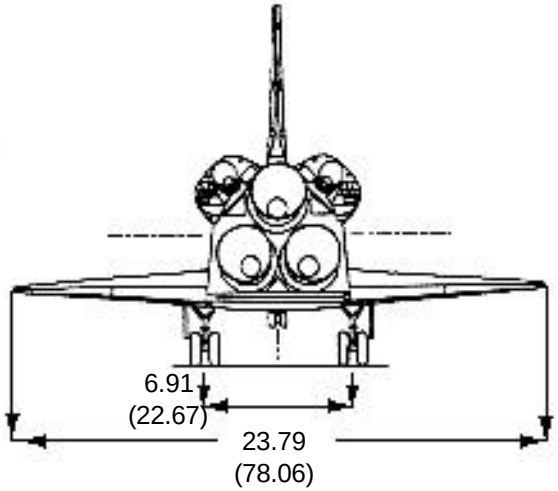
MINIMUM GROUND CLEARANCES

BODY FLAP (AFT END)	3.68 m	(12.07 ft)
MAIN GEAR (DOOR)	0.87 m	(2.85 ft)
NOSE GEAR (DOOR)	0.90 m	(2.95 ft)
WINGTIP	3.63 m	(11.92 ft)



OV102 COLUMBIA
OV103 DISCOVERY
OV104 ATLANTIS
OV105 ENDEAVOR





HAZARDOUS FLUIDS AND GASES

FLUID/GAS	TOXIC	FLAMMABLE	HYPERGOLIC
1. AMMONIA	X	X	X
2. BREATHING OXYGEN	NA	OXY	NA
3. FLUORINERT FC-40	NA	NA	NA
4. FREON-21	LOW	NA	NA
5. HALON 1301	LOW	NA	NA
6. HELIUM	NA	NA	NA
7. HYDRAULIC FLUID	NA	NA	NA
8. HYDRAZINE	X	X	X
9. LUBE OIL	NA	NA	NA
10. LIQUID HYDROGEN	NA	X	NA
11. LIQUID OXYGEN	NA	OXY	NA
12. MONOMETHYLHYDRAZINE	X	X	X
13. NITROGEN	NA	NA	NA
14. NITROGEN TETROXIDE	X	OXY	NA

HAZARDOUS FLUIDS AND GASES-Continued

NOTE: Reference page OV.8 number codes except items 15 and 16.

# Code	Fluid/gas	Specification	Location	System	Approx. total tank capacities kg (lbs)	Lower explosive limit (LEL)	Upper explosive limit (UEL)	Threshold limit valve (TLV) ppm	Description $m^3(ft^3)$
1	Ammonia	MIL-P-27406	Aft fuselage	ECLSS	44.45	16%	25%	50	Two tanks 0.051 (1.8)
2	Breathing oxygen (GO^2)	MIL-O-0272210D amendment 1	Mid fuselage	ECLSS (LSS)	32.21 (71)	(a)		(b)	One tank 0.143 (4.73) (mission kit only)
3	Freon-21 Dichloromono-fluoromethane ($CHCl^2F$)	BB-F-1421A type 21	Mid and aft fuselage	ECLSS	272.16 (600)	(a)		1000 (TWA)	System
4	Halon 1301 Bromotri-fluoromethane	MIL-M-12218B	Crew module fire extinguishers	Fixed	5.17 (11.4)	(a)		1000 (TWA)	Three tanks
				Portable	3.6 (8.4)			1000 (TWA)	Three bottles
5	Fluorinert FC-40	SE-S-0073 (MB0110-012)	Mid fuselage	EPS	35.11 (77)	(a)		(c)	Fuel cell coolant loops
6	Helium (HE)	MIL-P-27407 amendment 1	Fwd RCS module	Fwd RCS	3.63 (8)	(a)		(d)	Two tanks 0.049 (1.73)
			OMS/RCS modules	OMS	44.91 (99)				Two tanks 0.490 (17.3)
				Aft RCS	7.26 (16)				Four tanks 0.049 (1.73)
			Aft fuselage	MPS	22.68 (50)				Four tanks 0.134 (4.73) Two tanks 0.008 (0.29)
			Mid fuselage	MPS	77.56 (171)				Three tanks 0.049 (17.3) Three tanks 0.134 (4.73)
7	Hydrazine (N_2H_4)	MIL-P-26536C amendment 1	Aft fuselage	APU	476.28 (1050)	4.7%	100% @ 212^0 F	0.1	Three tanks 0.187 (6.6)
8	Hydraulic	MIL-H-83282A	Fwd, mid and aft fuselage, and wings	Hydraulic	382.3(e) (101)	204^0C (400^0F)		(c)	Three systems
		MIL-P-27201C	Landing gear struts	Landing gear	13.6 (30)	110^0C (230^0F)		(c)	Nose & main gear
9	Liquid hydrogen (LH_2)	MIL-P-27201B type II	Aft fuselage	MPS	169.19 (373)	4%	75% @ 68^0	(d)	Feedlines & SSME
		MIL-P-27201C grade A type I or II	Mid fuselage	EPS	166.92 (368)			(d)	Four tanks 0.606 (21.4)
		MIL-P-27201C grade A type I or II	Mid fuselage EDO Cryo Kit	EPS	166.92 (368)			(d)	Four tanks 0.606 (21.4)

HAZARDOUS FLUIDS AND GASES-Continued

NOTE: Reference page OV.8 number codes except items 15 and 16.

# Code	Fluid/gas	Specification	Location	System	Approx. total tank capacities kg (lbs)		Lower explosive limit (LEL)	Upper explosive limit (UEL)	Threshold limit valve (TLV) ppm	Description $m^3(ft^3)$
10	Liquid Oxygen (LO_2)	MIL-P-25508E type II grade F	Aft fuselage	MPS	222.8	(4896)			(a)	Feedlines & SSME
		MIL-P-255O8E type II grade F	Mid fuselage	EPS & LSS	1417.05	(3124)			(b)	Four tanks 0.318 (11.24)
		MIL-P-25508E type II grade F	Mid fuselage EDO Cryo Kit	EPS	1417.05	(3124)			(b)	Four tanks 0.318 (11.24)
11	Lube oil	MIL-L-23699C	Aft fuselage	APU	8.16	(18)	246^0 C 475^0 F		(c)	Three systems (cooling loops)
12	Monomethyl-hydrazine ($CH_3 NHN_2$)	MIL-P-27404A amendment 2	Fwd RCS module	Fwd RCS	428.2	(944)	2.5%	98% @ 1 atmosphere	0.2	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	872.73	(1924)				Two tanks 0.506 (17.88)
				OMS	4297.86	(9475)				Two tanks 2.547 (90)
13	Nitrogen (N_2)	MIL-P-27401C grade B	Mid fuselage	ECLSS	103.42	(228)	(a)		(d)	Four tanks (base-line) 0.134 (4.73)
14	Nitrogen tetroxide N_2O_4	MIL-P-26539C amendment	Fwd RCS module	Fwd RCS	664.25	(1464)	(a)		2.5	One tank 0.506 (17.88)
			OMS/RCS modules	Aft RCS	1329/40	(2928)				Two tanks 0.506 (17.88)
				OMS	7071.17	(15589)				Two tanks 2.547 (0.24)
15	Wate (deionized)	JSC-SPEC-C-20	Crew module	ECLSS	60.33	(133)	(a)		None	Two cooling loops
			Aft fuselage	Hydraulic	192.33	(424)				Three water spray boilers
				APU	4.3	(9.5)	Injector			One tank 0.007 (0.24)
16	Water (portable and waste)		Lower Equipment bay, crew module	LSS	381.0	(840)	(a)		None	Five tanks 0.761 (2.69)

(a) Does not apply
(b) No TLV, however, limits are 100% for 48 hour at 101 kN (1 atm) (upper limit, lower limit + 14%)
(c) No TLV, because of low vapor pressure, inhalation of vapors not encountered in normal use
(d) Simple asphyxiant, no TLV
(e) Measurement in litres (gallons) for hydraulic fluid

HAZARDOUS FLUIDS AND GASES-Continued

Anhydrous ammonia (NH3) - 99.5% (by weight) basic ammonia. This gas is normally a pungent, colorless vapor.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
1	Liquid anhydrous ammonia produces severe burns on contact. Gaseous anhydrous ammonia is a strong irritant and can damage the respiratory tract. Since ammonia vapor can be smelled at concentrations of 5.0 ppm in air, the odor normally provides adequate warning. Anhydrous ammonia gas in concentration of 1% by by volume can cause death in a few minutes. Concentrations of 0.05 to 0.1 can cause irritations to the eyes, respiratory tract and throat. TLV of anhydrous ammonia is given on page OV.9.	Remove the victim from the contaminated atmosphere. Apply artificial respiration if breathing has stopped. Provide positive pressure or mouth-to-mouth resuscitation if the victim is gasping for breath. If ammonia has contacted the eyes, flush with a gentle stream of water for at least 15 minutes and place in the care of a physician. If ammonia has contacted the skin, flush the area of contact with large amounts of water.	Standard firefighting protection clothing; a fire fighting crash hood or and a protective face/eye mask.	Entry into an ammonia atmosphere is extremely hazardous and is warranted only in extreme emergency conditions. Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Has a narrow flammability range i.e. 16.1 to 26.8 % by volume in air. Normally, the fire hazard is insignicant unless a large spill occurs.	Use water as a spray or fog to remove vapor and combat fires.

Oxygen (LO2, GO2)-A powerful oxidizer in both the liquid and gaseous states. The gas is colorless, orderless, and slightly heavier than air. The liquid is pale blue and is slightly more dense than water.

WARNING

When liquid oxygen is trapped in a closed system and refrigeration is not maintained, rupture of the system can occur. Liquid oxygen at a temperature above -83 ^{0}C (-181 ^{0}F) at an atmospheric pressure of 101kN (17.7 psi) expands to about 860 times its liquid volume. Liquid oxygen cannot be held in a liquid state at a temperature above -83^0 C (-181^0 F) regarless of the confining pressure.

2, 10	An oxygen-rich atmosphere can be ignited by a spark. Liquid oxygen is generally less dangerous than oxygen stored as a high-pressure gas. Liquid oxygen bolts (vaporized) at -147 ^{0} C (-297 ^{0} F) and instantly freezes any object that contacts it. **WARNING** Oxygen permeation of clothing is extremely dangerous if an ignition source is present.	If liquid oxygen contacts the skin, flush the affected area with water. If extensive burns result, contact a physician. **WARNING** Do not use fire blanket to cover personnel whose clothing is oxygen saturated.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Not required. However, approved respiratory protection will be worn when working in an atmosphere where there is a potential vapors. **WARNING** Do not enter areas with less than 18% oxygen unless self-contained respiratory equipment is immediately available.	Oxygen is nonflammable in normal concentrations. However, in high concentrations, oxygen reacts rapidly with flammable materials to form a shock-sensitive gel. **WARNING** Do not expose organic or flammable substances (oil, grease, liquid hydrogen, cloth, wood, paint, tar) to liquid oxygen. Areas having more than 20% oxygen are considered to be oxygen enriched and and the fire hazard greatly increased.	Use water to help prevent pure oxygen pockets, which result from LO2, or GO2 leaks. The fog should be directed into the gaseous oxygen. **WARNING** Direct water fog so that it will not blow back on fire fighting personnel. Combination of LO2 and any hydrocarbons impacted with 40 pounds of water pressure could detonate shock sensitive gels.

HAZARDOUS FLUIDS AND GASES-Continued

Freon-21 (Dichloromonofluoromethane (CHDL2F)) - A colorless, ordorless, nonflammable gas at standard temperature and pressure.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
3	The TLV of Freon-21 is given on page OV.9. Moderate concentrations can cause lightheadedness, shortness of breath and narcosis. Concentrations above 1000 ppm can cause arrhythmia (irregularity of the heart and pulse.	Remove the victim from the contaminated area and administer breathing oxygen. Apply artificial respiration if breathing has stopped. If Freon-21 has contacted the eyes. Flush with a gentle stream of water for at least 15 minutes. **WARNING** If the victim is unconscious or is having difficulty breathing. Do not administer adrenaline or a similar drug (can cause irregular heartbeat).	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Halon 1301 (Bromotriflouromethane (CBrF3)) - A colorless, ordorless, nonflammable gas at ambient temperature and pressure. Used as fire-extinguishing agent in Orbiter fixed and portable fire extinguishers.

4	The TVL of Halon 1301 is given on page OV.9. Moderate concentrations of 10 to 20% by volumn for 20 minutes can cause a general decrease in judgement ability and alertness.	Remove the victim from the contaminated area and administer breathing oxygen.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Florinert FC-40 (Florocarbon) - A fluorinated liquid used as a dielectric coolant in the fuel cells of the electrical power system (EPS). FC-40 is a stable liquid that is chemically inert, clear, colorless, ordorless, nonflammable, practically nontoxic at ambient temperature and pressure.

5	None defined at normal ground temperature and pressures. Exposure to temperatures of 315 ^{0}C (600 ^{0}F) may produce toxic products.	If FC-40 has contacted the eyes, flush with a gentle stream of water. If irritation develops, seek medical attention. Provide fresh air for excessive inhalation of vapors.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

Helium (He) - An inert nonflammable, nontoxic, colorless, ordorless gas at ambient temperatures.

6	Acts as a simple asphyxiant in concentrations where the oxygen level is reduced to less than 15%.	Move the victim to well-ventilated area. Use self-contained breathing apparatus, if necessary, apply artificial respiration and then obtain medical aid.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable	

HAZARDOUS FLUIDS AND GASES-Continued

Hydrazine (N_2H_4) and monomethylhydrazine(CH_3NHNH_2) - At room temperature, a clear, oily, water-white liquid with an ordor similar to ammonia.

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
7, 12	In contact with skin or eyes, liquid hydrazine can cause severe local damage or burns. It can penetrate skin to cause systemic effects similar to those produced when swallowed or inhaled. If inhaled, the vapor causes local irritation of the eyes and the respiratory tract. On short exposure, systemic effects involve the central nervous system with symtoms including tremors. On exposure to higher concentrations, convulsions and possible death follow. Repeated or prolonged exposure may cause toxic damage to the liver (fatty liver) and kidney (interstitial nephritis), and anemia. Do not exceed the exposure ceiling of the TVL for monoethylhydrazine. **WARNING** N_2H_4 and CH_3NHNH_2 are suspect carcinogens. CH_3NHNH_2 is a suspect teratogen. The hydrazine odor threshold is much greater than the TVL. Do not, therefore, depend on the sense of smell to provide sufficient warning of hazardous levels.	Remove the victim from the contaminated environment. Remove all contaminated clothing. Wash propellant from the skin with water. If eyes have been exposed, flush gently with water for at least 15 minutes. Obtain immediate medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. **WARNING** Avoid skin contact.	Entry into a hydrazine atmosphere is extremely hazardous and is warranted only in extreme emergency conditions. Under such conditions, self-contained breathing equipment that uses oxygen should be of the rebreathing type to minimize release of oxygen to the atmosphere. If demand-type equipment is used, compressed air rather than oxygen must be used.	Hydrazine is a strong reducing agent. It is hypergolic with oxidizers such as nitrogen tetroxide (N_2O_4) and metal oxides of iron, copper, lead, etc.	In all cases involving a major leak, blanket the area with water fog. Water is the most effective agent for completely extinguishing air supported hydrazine fires. Water fog can be used for combating spill-type fires. Effective use of water minimizes the reignition and flashback hazard.

Hydraulic fluid - Two types: (1) used in landing gear struts (MIL-H-5606) and (2) used in the hydraulic system (MIL-H-83282). Both are red in color.

8	None defined at standard temperature and pressure.	If eyes are affected, flush with a gentle stream of water.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment equipment will be worn at all times when working in an area where the potential for exposure exists.	None defined at standard temperature and pressure. High-pressure leaks present a fire hazard.	Use standard techniques.

HAZARDOUS FLUIDS AND GASES-Continued

Pg OV.8 # Code	Health Hazard	First Aid	Protective Clothing	Respiratory Protection	Fire Hazard	Fire Control
Liquid hydrogen (LH2) - A low viscosity liquid that is nontoxic, transparent, colorless, and odorless.						
9	As a cryogenic liquid (low temperature), will cause a serious burn (frostbite) if it contacts the skin. Gaseous hydrogen (GH2) acts as simple asphyxiant. High concentrations will not produce systemic effects, but if high enough, can reduce atmospheric oxygen, causing oxygen deprivation.	Remove the victim to a well ventilated area. If breathing has stopped, apply artificial respiration and obtain medical aid. If liquid hydrogen contacts the skin, flush the affected area with water. Extensive burns (frostbite) require prompt medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. **WARNING** Liquid hydrogen will saturate normal clothing rendering it extremely flammable.	Entry into a hydrogen atmosphere is extremely dangerous and is warranted only in an extreme emergency. Under such conditions self contained breathing equipment that use oxygen should be of the rebreathing type to minimize release of oxygen into the atmosphere. If demand-type equipment is used, compressed air rather than oxygen must be used.	Hydrogen gas is highly combustible with air over a wide range of mixtures. Hydrogen burns in air with an invisible flame if there are no impurities. Liquid hydrogen fires are of short duration because liquid hydrogen evaporates rapidly. Detonation does not result as long as mixtures formed from liquid hydrogen evaporating into the atmosphere are not confined. **WARNING** In enclosed spaces, evacuate all personnel when the hydrogen atmospheric concentrations exceeds 0.8 % by volume; this amount is 20% of the lower flammability limit of 4 % by volume.	Allow controlled burning of a hydrogen fire until the flow can be shut off. Fires can also be controlled effectively by using very high concentrations of water. If possible, spray large quantities of water to cool adjacent surfaces. **WARNING** Eliminate all ignition sources. If hydrogen continues to leak after hydrogen flames are extinguished, an explosive cloud of combustible gas may be formed. Static electricity from clothing can cause ignition.
Nitrogen (N2) - A gas at ambient temperature and pressure that is inert, nontoxic, colorless, and nonflammable.						
13	Acts a simple asphyxiant where the oxygen level has been reduced to less than 15%.	Move the victim to a well ventilated area. Use self contain breathing apparatus if necessary. If required, apply artificial respiration and obtain medical aid.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask.	Approved respiratory protection equipment will be worn at all times when working in an area where the potential for exposure exists.	Nonflammable.	
Nitrogen textroxide (N2O4) - Fumes vary in color from light orange to reddish brown to blue or green at low temperature.						
14	Skin contact with liquid nitrogen tetroxide will cause burns similar to nitric acid. Brief contact results in a yellow stain. If contact is more than momentary, a severe chemical burn will result. Liquid nitrogen tetroxide in the eyes will cause blindness. If swallowed, it will cause death from severe internal burns. Prolonged inhalation of the fumes will result in irritation of respiratory track and may cause pulmonary edema (lungs fill with water).	Remove the victim from the contaminated area. Remove all contaminated clothes and wash the victim with liberal amounts of water. If eyes have been exposed, flush with water for at least 15 minutes and obtain immediate medical attention.	Standard firefighting protection clothing; a firefighting crash hood or equivalent; and a protective face/eye mask. CAUTION Do not use Type A and Type B canister gas masks (with soda lime or soda lime-activated carbon fills). Those masks do not provide adequate protection.	Entry into a nitrogen tetroxide atmosphere is extremely hazardous and is warranted only in an extreme emergency. Approved respiratory equipment will be worn at all times when working in an area where the potential for exposure exists. **WARNING** Fires involving N2O4 burn vigorously and emit toxic fumes. N2O4 containers exposed to fire should be kept cool by applications of water (if possible).	Nonflammable, but will actively support combustion when mixed with a fuel. The oxygen content of N2O4 is about 70% by weight. Nitrogen tetroxide is hypergolic with a number of fuels, including hydrazine. Smoke and fumes from these fires are toxic and should be approached from the upwind side.	For a major leak, blanket the area with water fog. Water is the most effective agent for completely extinguishing air-supported fires. Water can be used for combating spill-type fires. Effective use of water minimizes the reignition and flashback hazard.

HAZARDOUS FLUIDS AND GASES-Continued

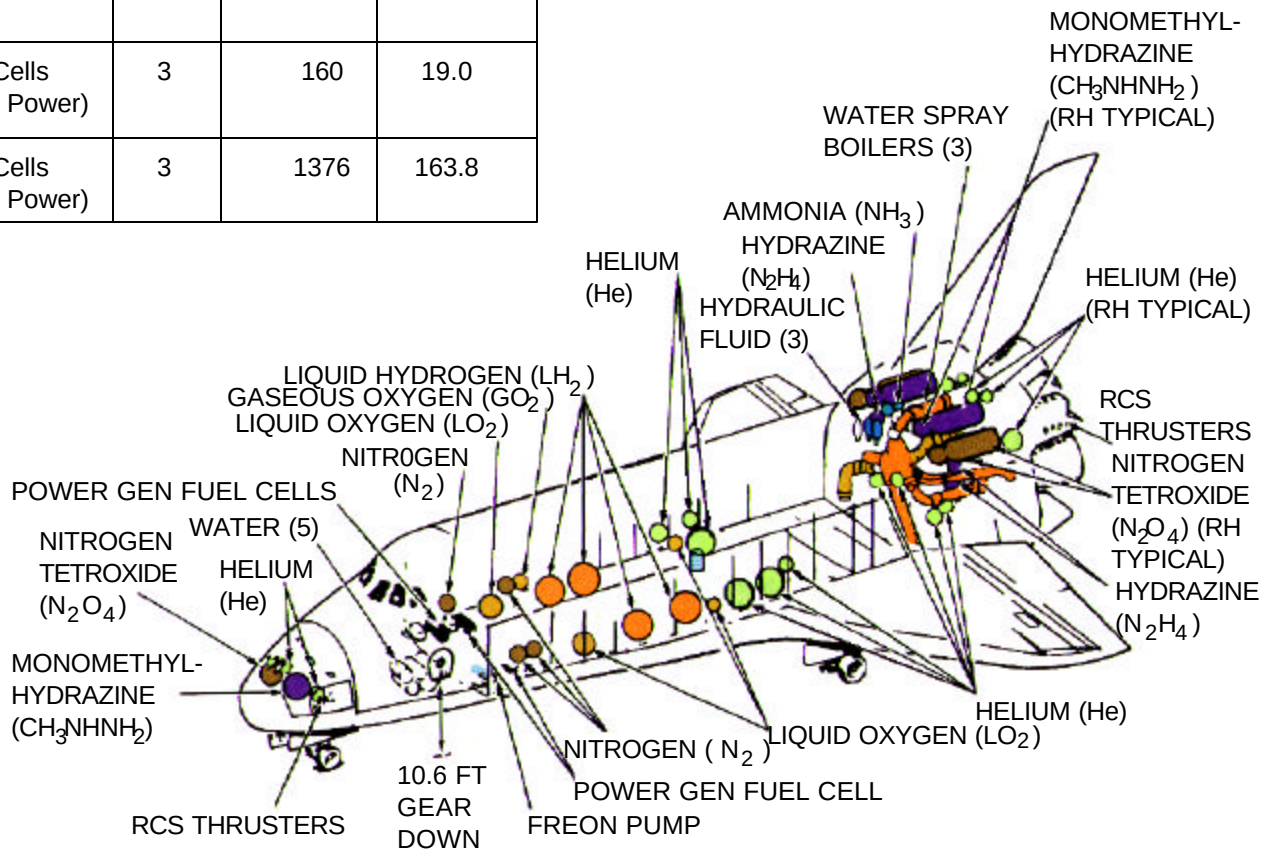
PRINCIPAL HAZARDOUS FLUIDS AND GASES					
CHEMICAL	CHARACTERISTIC	USE	# OF TANKS	LANDING QUANTITY	
				LB	GAL.
Monomethylhydrazine (CH_3NHNH_2)	Flammable, Toxic	Propellant (OMS-RCS)	5	1796	213.4
Nitrogen Tetroxide (N_2O_4)	Acid Forming,Toxic	Propellant OMS-RCS	5	2945	350.6
Hydrazine (N_2H_4)	Flammable, Toxic	Auxilliary Power Unit	3	490	58.3
Anhydrous Ammonia (NH_3)	Caustic, Toxic	Coolant	2	98	17.2
Liquid Hydrogen (LH_2)	Cyrogenic Oxidizer	Fuel Cells (Elec. Power)	3	160	19.0
Liquid Oxygen (LO_2)	Cyrogenic Oxidizer	Fuel Cells (Elec. Power)	3	1376	163.8

NOTES:

- Quantities shown are estimated maximums following a nominal 5 day mission.
- Quantities may vary depending on extent of mission completion prior to landing.
- Payloads, if present, may contain additional hazardous fluids and gases.
- Gaseous oxygen is a mission kit and may not always fly.

WARNING

Orbiter crash or emergency landing may result in toxic material spill and/or vapors. Rescue and ground handling personnel must wear protective clothing within a 200 foot radius of the orbiter vehicle. The downwind area must remain clear of unprotected personnel until verified safe.



ONBOARD LANDING QUANTITIES

WORST-CASE LANDING QUANTITIES ONBOARD AN ORBITER

LEGEND KEY: kg (lb) *standard cubic feet (scf) liter (gal)

FLUID/GAS	RTLS	TAL	AOA	End of Nominal 7 Day Mission
FWD FUSELAGE				
FWD RCS Helium	3.6 (8) 773.7*	3.6 (8) 773.7*	3.6 (8) 773.7*	3.6 (8) 773.7*
FWD RCS Monomethlhydrazine	402.8 (888)	385.6 (850)	66.7 (147)	66.7 (147)
	509.0 (134.5)	487.5 (128.8)	38.2 (10.1)	38.2 (10.1)
FWD RCS Nitrogen tetroxide	640.9 (1413)	613.3 (1352)	103.4 (228)	103.2 (228)
	442.1 (116.8)	422.8 (111.7)	71.2 (18.8)	71.2 (18.8)
MID FUSELAGE				
Helium	77.6 (171) 16537.7*	77.6 (171) 16537.7*	77.6 (171) 16537.7*	77.6 (171) 16537.7*
Liquid Hydrogen	165.1 (364)	164.2 ((362)	163.3 (360)	50.8 (112)
	2334.9 (616.91)	2322.5 (613.6)	2309.6 (610.2)	718.4 (189.8)
Liquid Oxygen	1389.0 (3082)	1397.0 (3080)	1388.9 (3062)	440.9 (972)
	1224.1 (323.4)	1223.3 (323.2)	1261.1 (321.3)	386.1 (102)
Gaseous Nitrogen	119.75 (264) 3641.4*	119.8 (264) 3641.4*	119.8 (264) 3641.4*	101.6 (224) 3089.7*
AFT FUSELAGE				
Ammonia	44.5 (98)	44.5 (98)	44.5 (98)	44.5 (98)
	65.1 (17.2)	65.1 (17.2)	65.1 (17.2)	65.1 (17.2)
Helium	22.7 (50) 4835.6*	22.7 (50) 4835.6*	22.7 (50) 4835.6*	22.7 (50) 4835.6*
Hydrazine	381.9 (842)	359.7 (793)	226.8 (500)	256.3 (565)
	378.9 (100.1)	365.5 (94.2)	224.8 (59.4)	254.0 (67.1)
Hydraulic Fluid	59.4 (131)	59.4 (131)	59.4 (131)	59.4 (131)
	69.3 (18.3)	69.3 (18.3)	69.3 (18.3)	69.3 (18.3)
Gaseous Nitrogen	3.4 (7.5)	3.4 (7.5)	3.4 (7.5)	3.4 (7.5)
	103.4	103.4	103.4	103.4
Lube Oil	8.2 (18)	8.2 (18)	8.2 (18)	8.2 (18)
	8.7 (2.3)	8.7 (2.3)	8.7 (2.3)	8.7 (2.3)
OMS oods				
Helium	52.2 (115) 11121.9*	52.2 (115) 1112.1.9*	52.2 (115) 1112.9*	52.2 (115) 1112.9*
Monomethylhydrazine	1390.3 (3065)	1115.9 (2460)	510.8 (1126)	555.7 (1225)
	1757.8 (464.4)	1410.7 (372.7)	645.7 (670.6)	702.5 (185.6)
Nitrogen Tetroxide	2736.6 (6033)	2232.2 (4921)	791.1 (1744)	708.5 (1562)
	1887.2 (498.6)	1539.4 (406.7)	545.4 (144.1)	488.6 (129.1)

Crew Module Airlock

Inside each extra vehicular mobilty unit (EMU) - all landings.

Primary gaseous oxygen system - 0.27 (0.6) pr 7.2 scf at 900 psi in each of two tanks.

Second gaseous oxygen system - 0.59 (1.3) or 16.0 scf at 6000 psi in each of two tanks.

ONBOARD LANDING QUANTITIES-Continued

LEGEND KEY: kg (lb) *standard cubic feet (scf) liter (gal)

WORST-CASE LANDING QUANTITIES ONBOARD AN EXTENDED DURATION ORBITER

FLUID/GAS	RTLS	TAL	AOA	End of Nominal 7 Day Mission
FWD FUSELAGE				
FWD RCS Helium	3.6 (8) 773.7*	3.6 (8) 773.7*	3.6 (8) 773.7*	3.6 (8) 773.7*
FWD RCS Monomethlhydrazine	298.0 (657)	280.3 (618)	64.0 (141)	640 (141)
	376.6 (99.5)	354.3 (93.6)	81.0 (21.4)	81.0 (21.4)
FWD RCS Nitrogen tetroxide	480.8 (1060)	452.2 (997)	106.1 (2348)	106.1 (2348)
	331.6 (87.5)	311.9 (82.4)	73.0 (19.3)	73.0 (19.3)
MID FUSELAGE				
Helium	77.6 (171) 16537.7*	77.6 (171) 16537.7*	77.6 (171) 16537.7*	77.6 (171) 16537.7*
Liquid Hydrogen	330.2 (728)	329.3 (726)	328.4 (724)	91.2 (201)
	4670.3 (1233.9)	4657.4 (1230.5)	4644.6 (1227.1)	1289.5 (340.7)
Liquid Oxygen	2798.7 (6170)	2797.8 (6168)	2789.6 (6150)	802.0 (1768)
	2450.4 (647.4)	2449.7 (647.2)	2442.5 (645.3)	702.1 (185.5)
Gaseous Nitrogen	149.7 (330) 4551.7*	149.7 (330) 4551.7*	149.7 (330) 4551.7	102.0 (225) 3103.4*
AFT FUSELAGE				
Ammonia	44.5 (98)	44.5 (98)	44.5 (98)	44.5 (98)
	65.1 (17.2)	65.1 (17.2)	65.1 (17.2)	65.1 (17.2)
Helium	22.7 (50) 4835.6*	22.7 (50) 4835.6*	22.7 (50) 4835.6*	22.7 (50) 4835.6*
Hydrazine	345.2 (761)	322.1 (710)	190.1 (419)	222.3 (490)
	342.2 (90.4)	319.5 (84.4)	188.5 (49.8)	220.3 (58.2)
Hydraulic Fluid	59.4 (131)	59.4 (131)	59.4 (131)	59.4 (131)
	69.3 (18.3)	69.3 (18.3)	69.3 (18.3)	69.3 (18.3)
Gaseous Nitrogen	3.4 (7.5)	3.4 (7.5)	3.4 (7.5)	3.4 (7.5)
	103.4	103.4	103.4	103.4
Lube Oil	8.2 (18)	8.2 (18)	8.2 (18)	8.2 (18)
	8.7 (2.3)	8.7 (2.3)	8.7 (2.3)	8.7 (2.3)
OMS oods				
Helium	52.2 (115) 11121.9*	52.2 (115) 1112.1.9*	52.2 (115) 1112.9*	52.2 (115) 1112.9*
Monomethylhydrazine	1249.2 (2754)	697.6 (1538)	376.5 (830)	816.5 (1800)
	1579.5 (417.3)	881.9 (233)	476.2 (125.8)	1032.2 (272.7)
Nitrogen Tetroxide	1178.5 (4444)	1030.1 (2430)	686.3 (1393)	1235.6 (2951)
	812.6 (214.7)	710.4 (187.7)	473.1 (125.0)	852 (225.1)

Crew Module Airlock

Inside each extra vehicular mobilty unit (EMU) - all landings.

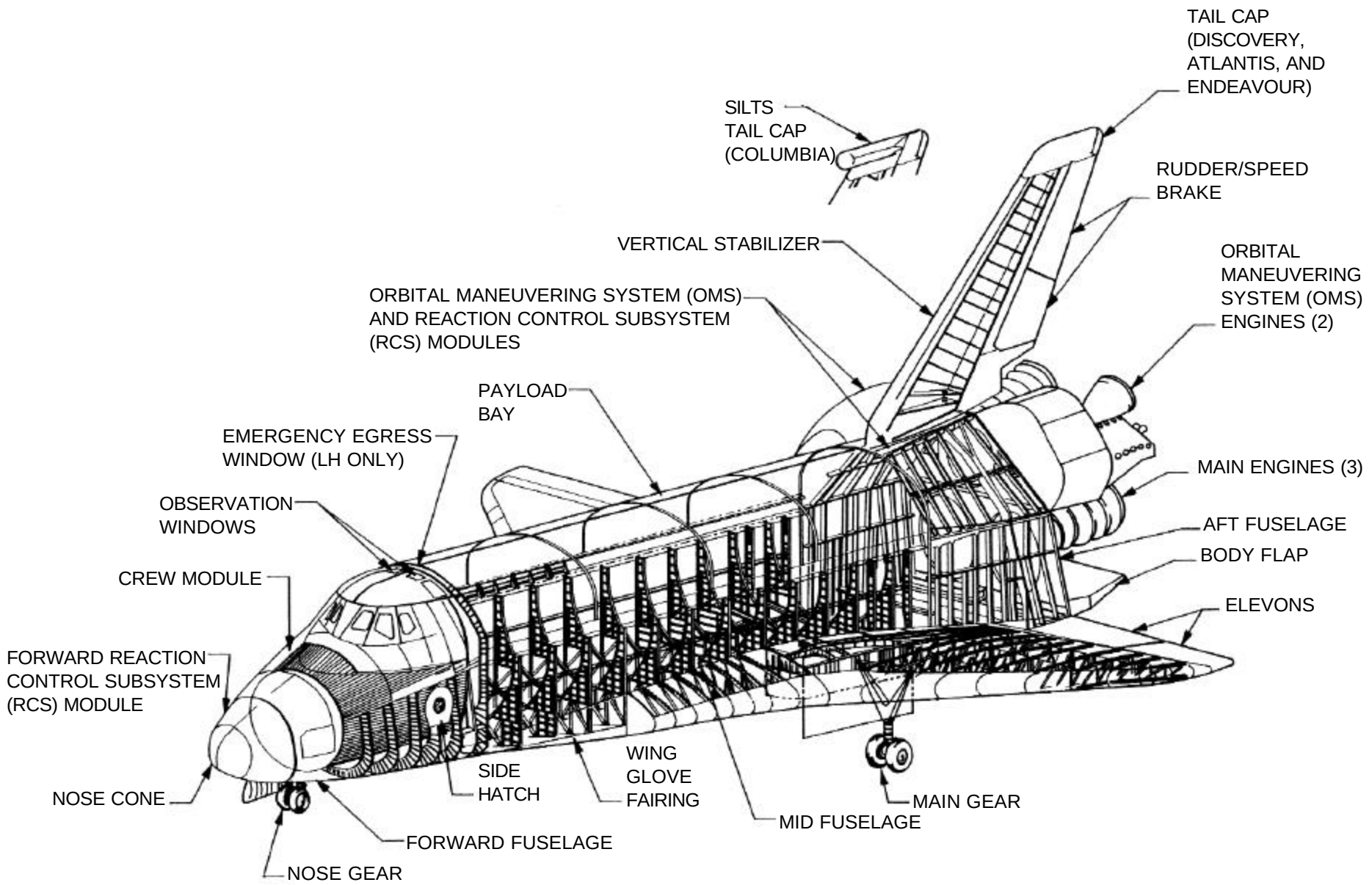
Primary gaseous oxygen system - 0.27 (0.6) pr 7.2 scf at 900 psi in each of two tanks.

Second gaseous oxygen system - 0.59 (1.3) or 16.0 scf at 6000 psi in each of two tanks.

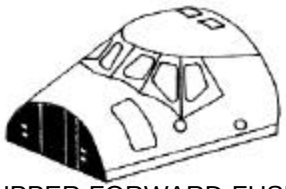
DANGER AREAS/SAFETY PRECAUTIONS
HAZARDOUS MATERIALS, FLUIDS & GASES

DANGER AREA	PERSONNEL ACTION
CAUTION Monomethylhydrazine (CH_3NHNH_2) in contact with metallic oxides or other oxidizing agents can ignite.	Do not park vehicles over metal drains.
NOTE: Nitrogen tetroxide (N_2O_4) and monomethylhydrazine may be venting through the relief valves unless each system has been safed.	Stay upwind of venting gas. Wear protective clothing and recommended air breathing device.
Forward and aft reaction control subsystem (RCS) thruster nozzles and relief valve vent ports.	Stand clear.
Main landing gear/tires/wheels could explode. Peak temperatures may not be reached for 45 minutes.	Do not approach from the sides.
Main landing gear tire fire. Peak temperatures may be reached 45 minutes after a hard-braking landing which could ignite the rubber tires.	Approach upwind and apply large amounts of water to cool the brakes and to extinguish the burning tires.
Metals (composites) Berylium: windshield frames, ET doors, and brake structure Aluminum boron: truss members in the wing feed-through section Epoxy boron: truss members of the main propulsion system thrust structure, aft fuselage Although not easily ignited, these metals will burn at elevated temperatures and produce toxic compounds that are hazardous to health.	MET-L-X may be used on brake fires. Exercise caution. Although small amounts of water accelerate these types of metal fires, rapid application of large amounts of water is effective in extinguishing these fires because of the cooling effect of water. If water or foam is used, wear complete protective clothing and NIOSH-approved positive pressure breathing equipment.
Fluids/gases are flammable and hazardous.	Exercise caution to prevent exposure.
External surfaces will be at elevated temperature.	Wear proper clothing to prevent injury.
Hydrogen overboard vents, 8-in. fill and drain, and 17-in. Orbiter/external tank (ET) disconnects. Autoignition may result from high surface temperatures. Note that the flame of pure hydrogen is invisible.	Exercise caution.
Switches.	Do not operate any switch other than those specifically identified.
Emergency egress window that is to be jettisoned (all vehicles).	Move to position out of range of debris.
Emergency jettison of the side entry/egress hatch (all vehicles).	Move to position out of range of jettisoned hatch.
Inadvertant deployment of drag chute after rollout (all vehicles).	Avoid area 10 degrees left and 47 degrees right of Orbiter centerline and 100 feet aft until pyrotechnic circuits are safed.

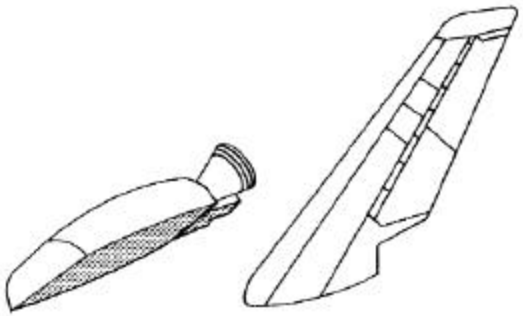
ORBITER STRUCTURE



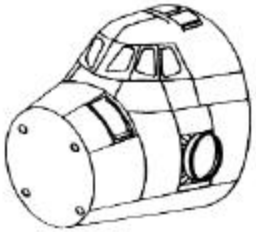
ORBITER STRUCTURE-Continued



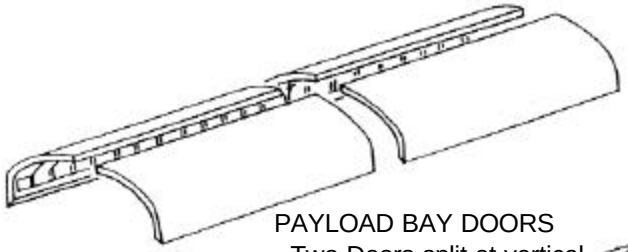
UPPER FORWARD FUSELAGE
- Skin and Stringer



VERTICAL STABILIZER
- Skin and Stringer Fin Covers
- Honeycomb Rudder Cover
- Machined Spars
- Sheet Metal Ribs



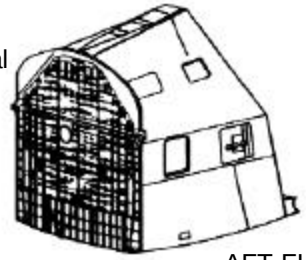
CREW MODULE (CABIN)
- Floating
- Welded Skin



PAYLOAD BAY DOORS
- Two Doors split at vertical
- Graphite Epoxy

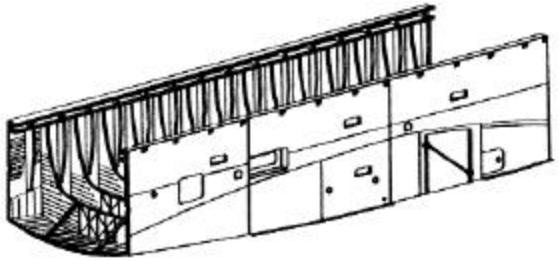
ORBITAL MANEUVERING SYSTEM (OMS)/REACTION CONTROL SUBSYSTEM (RCS) MODULE (TYPICAL)
- Skin and Stringer
- Graphite Epoxy and Milled Skin
- Titanium Thermal Barrier

FORWARD REACTION CONTROL SUBSYSTEM (RCS) MODULE
- Skin and Stringer



AFT FUSELAGE
- Integrally Machined Skin/ Stiffner Shell
- Titanium/Boron Epoxy Thrust Structure

BODY FLAP



MID FORWARD FUSELAGE
- Skin and Stringer Honeycomb Panels

LOWER FORWARD FUSELAGE
- Riveted Skin and Stringer

WING
- Skin and Stringer
- Web and Truss Spars

ORBITER STRUCTURE AND SURFACE TEMPERATURES

OV 102 COLUMBIA

- RCC- REINFORCED CARBON-CARBON
- HRSI- HIGH TEMPERTURE REUSABLE SURFACE INSULATION
- LRSI- LOW TEMPERATURE REUSABLE SURFACE INSULATION
- FRSI- FELT REUSABLE SURFACE INSULATION (NOMEX FELT)
- METAL OR GLASS
- AFRSI- ADVANCED FLEXIBLE REUSABLE SURFACE INSULATION (QUILTED)

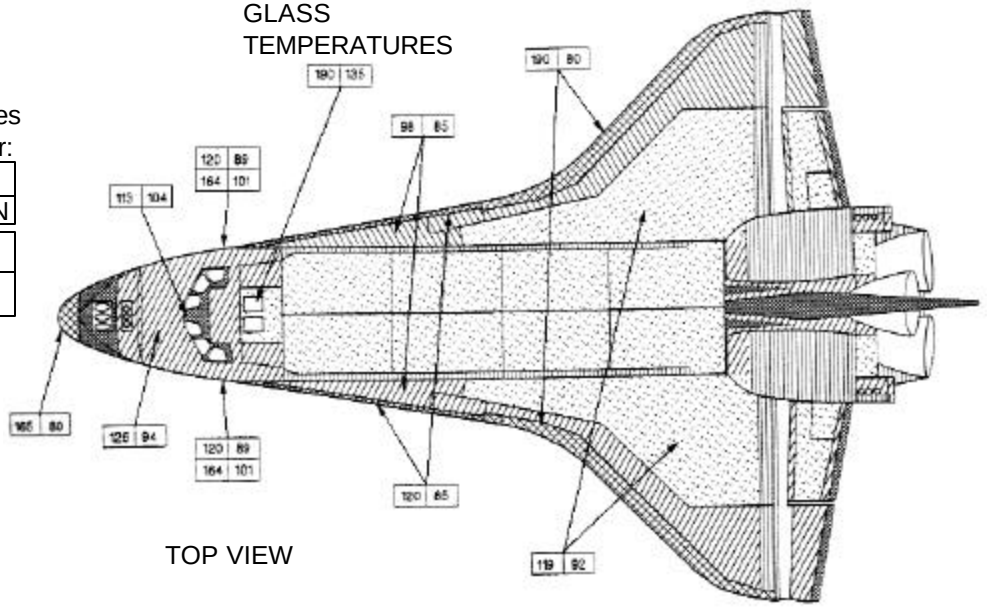
NOTE:

- Post touchdown temperatures of the orbiter are indicated in degrees fahrenheit in the following manner:

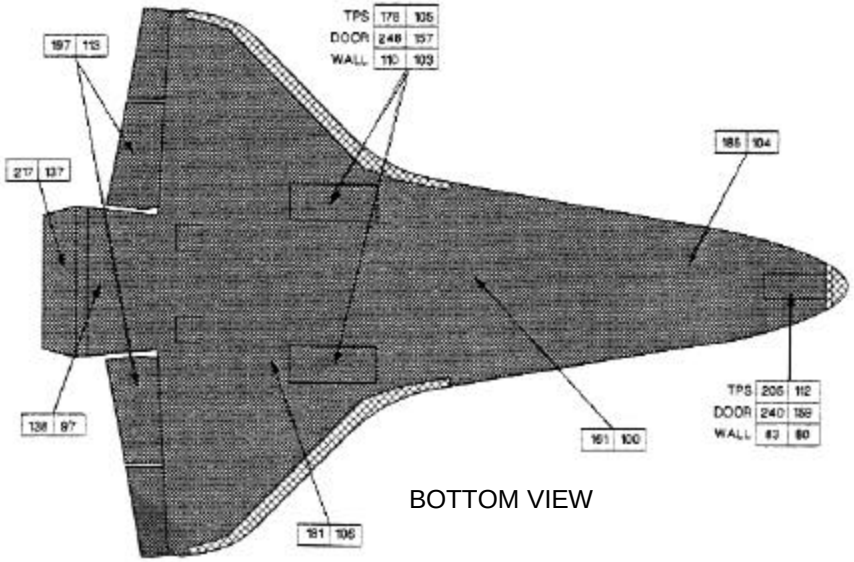
COMPONENT MEASURED	TOUCHDOWN +4 MIN	TOUCHDOWN +30 MIN
THERMAL PROTECTION SYSTEM (TPS) -		
STRUCTURE -		

- Single-level boxes indicate TPS temperature only.

GLASS TEMPERATURES

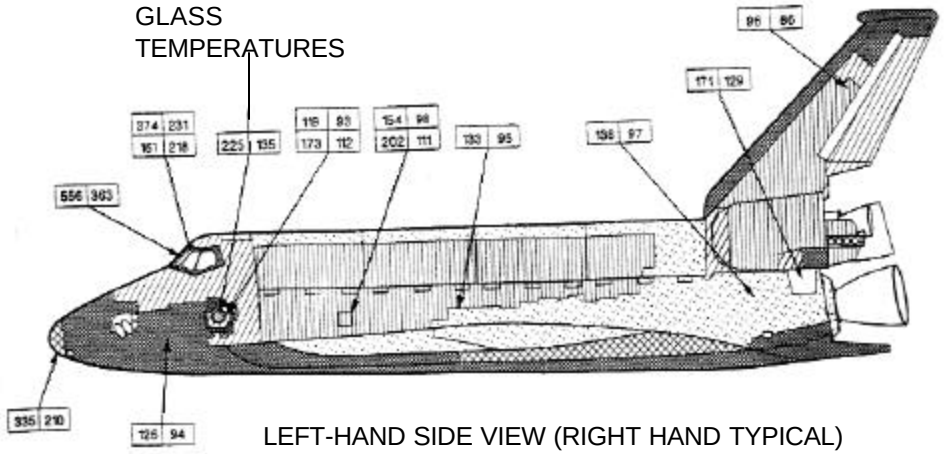


TOP VIEW



BOTTOM VIEW

GLASS TEMPERATURES



LEFT-HAND SIDE VIEW (RIGHT HAND TYPICAL)

ORBITER STRUCTURE AND SURFACE TEMPERATURES-Continued
OV 103 DISCOVERY, OV 104 ATLANTIS, AND OV 105 ENDEAVOUR

- RCC- REINFORCED CARBON-CARBON
- HRSI- HIGH TEMPERTURE REUSABLE SURFACE INSULATION
- LRSI- LOW TEMPERATURE REUSABLE SURFACE INSULATION
- FRSI- FELT REUSABLE SURFACE INSULATION (NOMEX FELT)
- METAL OR GLASS
- AFRSI- ADVANCED FLEXIBLE REUSABLE SURFACE INSULATION (QUILTED)

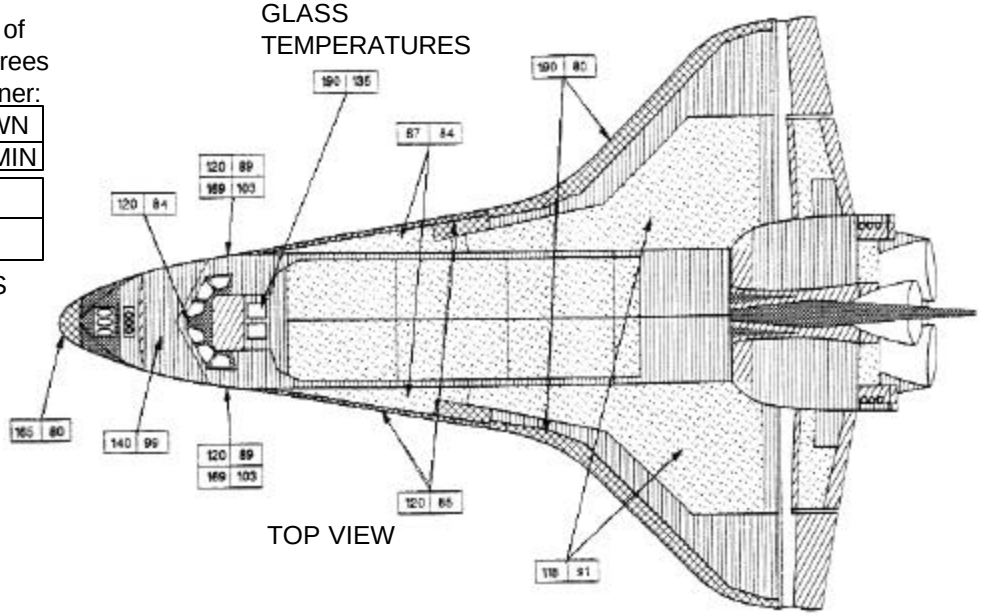
NOTE:

- Post touchdown temperatures of the orbiter are indicated in degrees fahrenheit in the following manner:

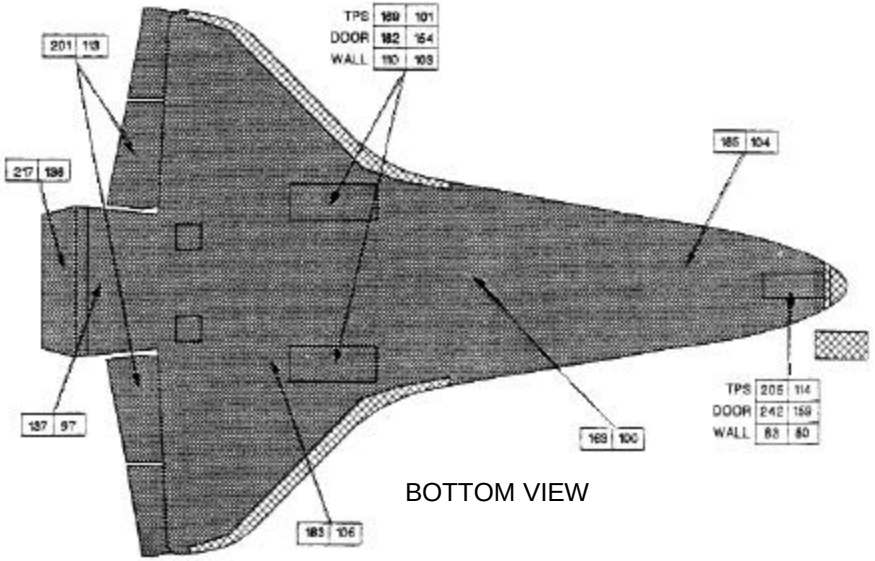
COMPONENT MEASURED	TOUCHDOWN +4 MIN	TOUCHDOWN +30 MIN
THERMAL PROTECTION SYSTEM (TPS) -		
STRUCTURE -		

- Single-level boxes indicate TPS temperature only.

GLASS TEMPERATURES

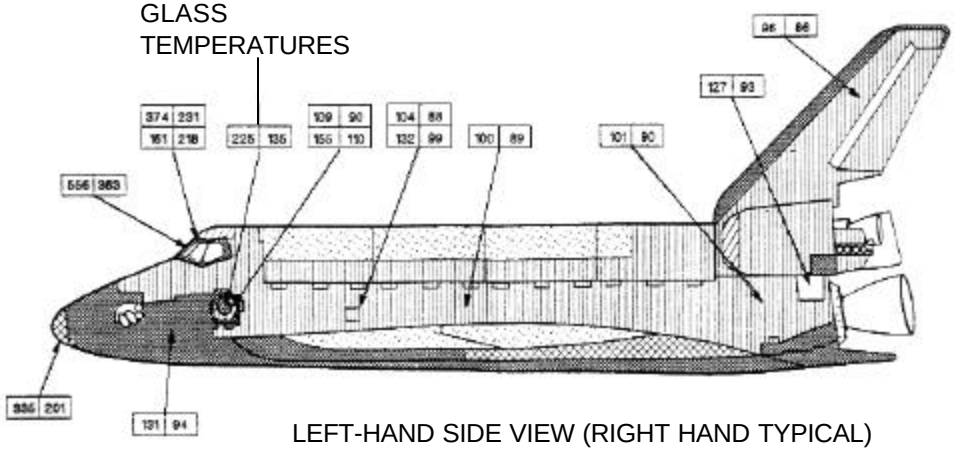


TOP VIEW



BOTTOM VIEW

GLASS TEMPERATURES



LEFT-HAND SIDE VIEW (RIGHT HAND TYPICAL)

ORBITER HAZARDS

WARNING

- The reaction control subsystem (RCS) exhaust plumes identify those areas that should be avoided. Do not approach the orbiter in line of any thruster exhaust. Do not stand in line with or within 50 ft. of thruster line.
- Personnel and vehicles should stay out of the possible wheel/tire fragmentation area for 45 minutes postlanding.
- Wheels are equipped with fusible plugs, to relieve excessive tire pressure due to temperature buildup.
- The trajectory of the outer egress window and side hatch may vary from envelope shown depending on attitude of orbiter and wind conditions.

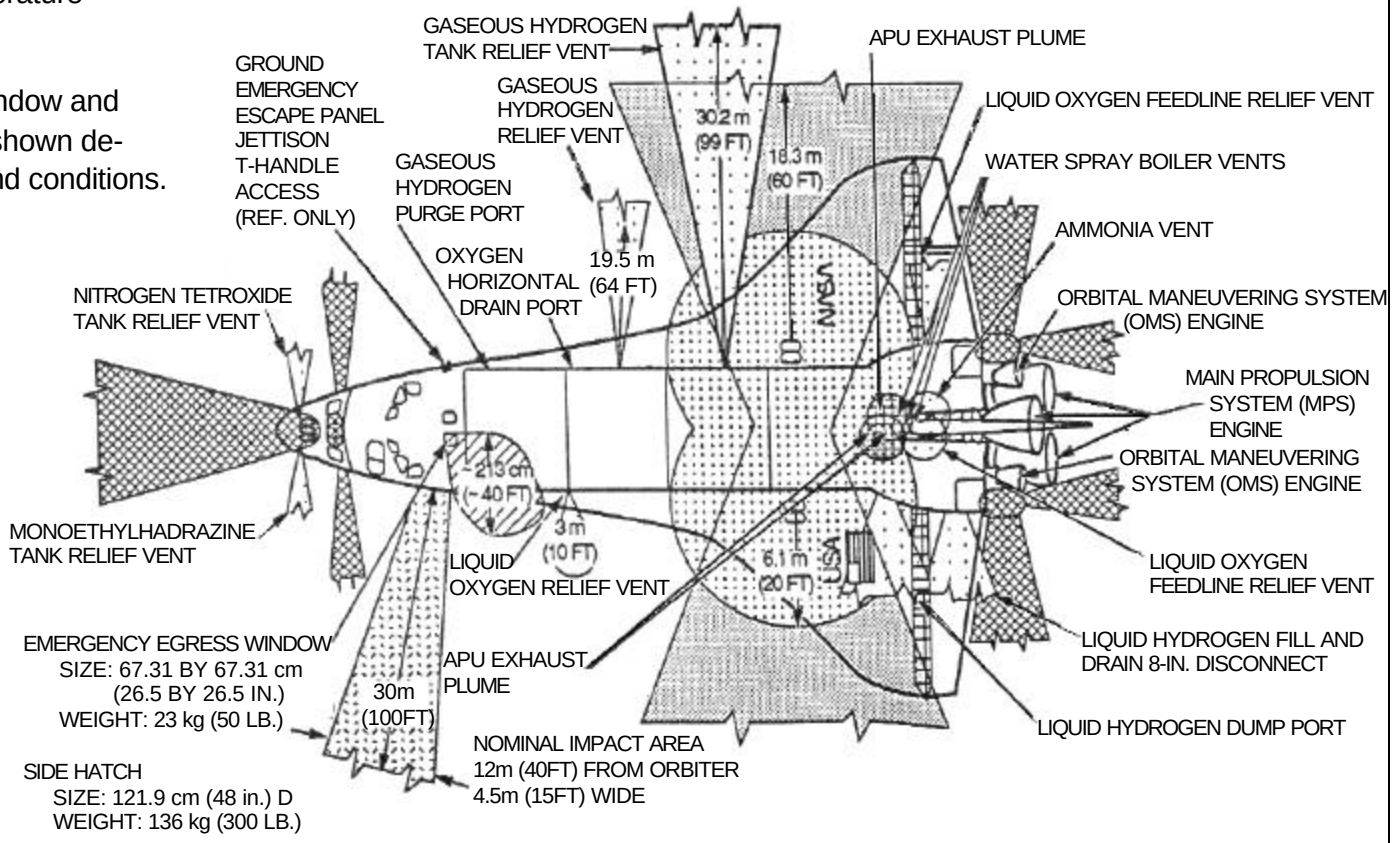
NOTE:

- Elevated surface temperatures are present following landing. Temperatures of the nose cone, wing leading edges, and glass and metal surfaces may be as high as 556 degrees F 4 minutes after landing and 363 degrees F 30 minutes after landing.
- Auxiliary power units (APU) vent upward. Flames may be present.
- Ammonia venting will normally occur for 20 to 30 minutes after landing.

- Pyrotechnic devices are located in:
  - Each landing gear uplock.
  - Crew compartment fire extinguisher system
  - Payload bay area
- Payloads, if installed, can be expected to present hazards, including pyrotechnics and liquid or solid rocket fuel.
- The orbiter vehicle contains approximately 5000 lbs. of composite fibers located in the nose cap, leading edge of the wings, and payload bay doors.

DANGER AREAS

- WHEEL/TIRE FRAGMENTATION
- HOT BRAKES/WHEEL
- AUXILIARY POWER UNIT (APU) EXHAUST PLUME
- REACTION CONTROL SUBSYSTEM (RCS) EXHAUST PLUME
- EMERGENCY EGRESS WINDOW HAZARD AREA
- SIDE HATCH JETTISON HAZARD AREA
- FLUID/GASES



ORBITER HAZARDS-Continued

WARNING

- Reaction Control Subsystem (RCS) may be leaking upon landing. A walk around check with a sniffing device is required if leaking is suspected. Ignition of plume is dangerous to personnel.

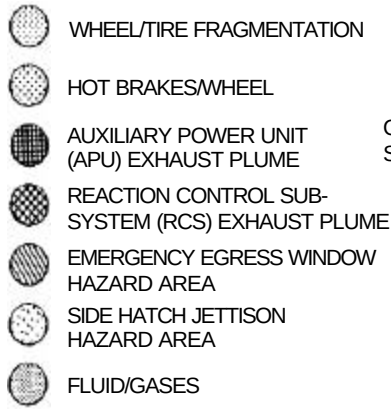
- The orbiter has two pyrotechnic hatches. Do not approach without communications with the orbiter. If no communication is possible, enter through top hatches. Side hatch can only be safed from the inside. Approaching the side hatch during jettison will cause death or injury to personnel.

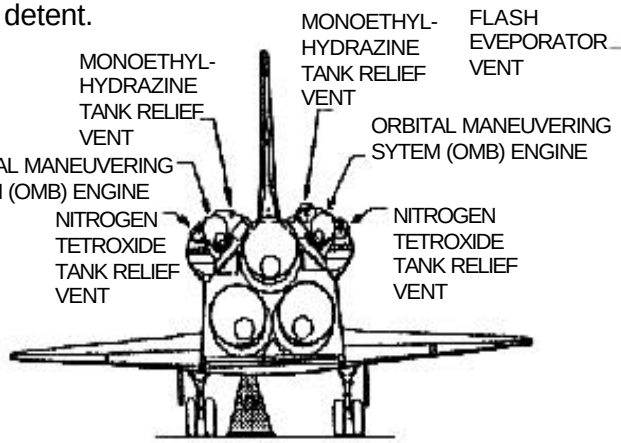
- During emergency powerdown and egress: evacuate all non-essential personnel immediately to the 1250 foot explosive safety and upwind safety/security perimeter.

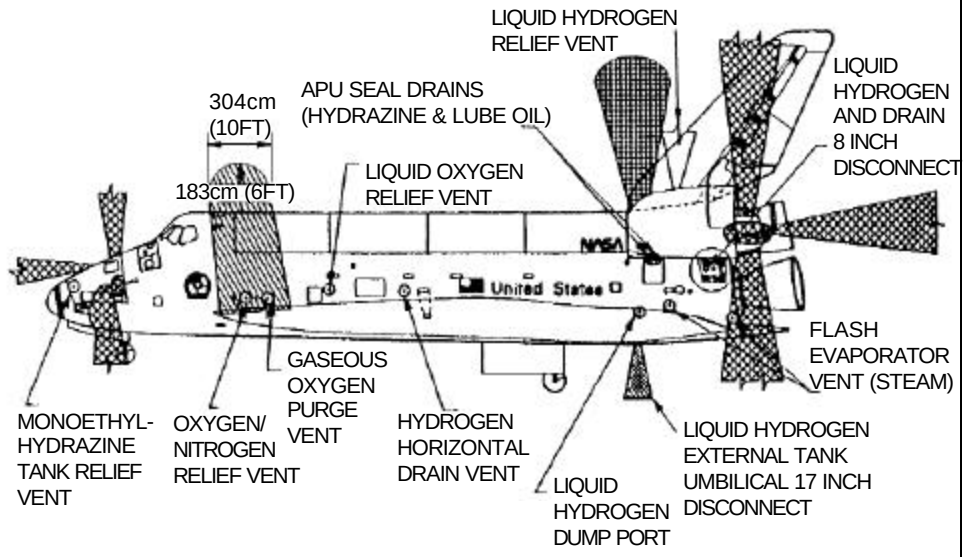
- Atmosphere around the orbiter is assumed toxic and hazardous until checked. Decontaminate rescue/hazard assessment personnel if toxics have been detected. Look for visible liquid/vapor clouds or toxic vapor detectors indicate contamination or at crew member request.

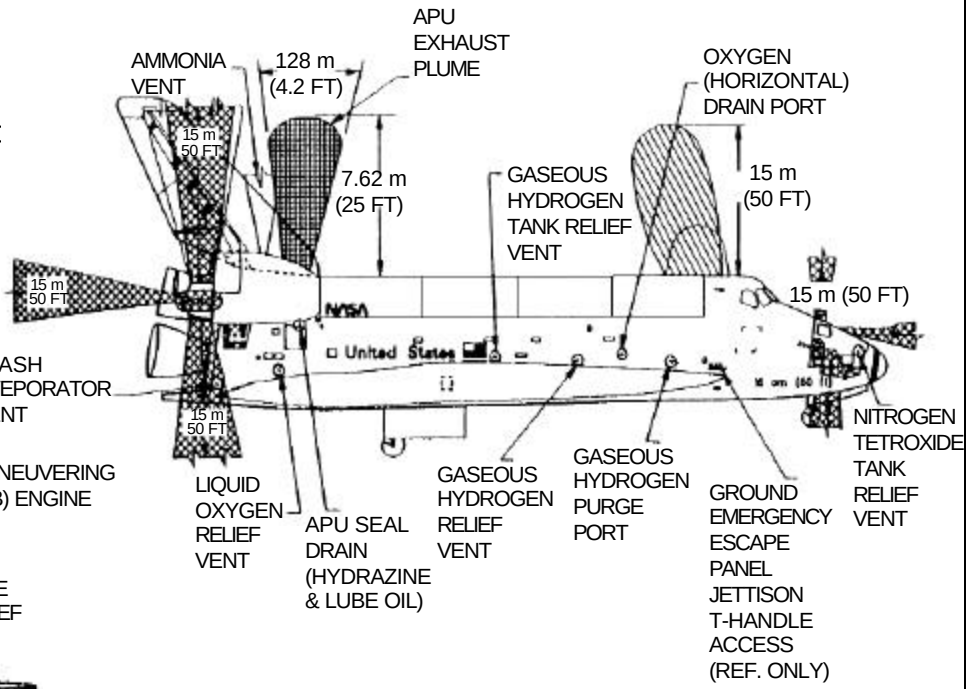
NOTE:

The two minute wait is for normal operations. Only 30 second wait for depressurization is required during emergencies for the side hatch after turning handle from detent.









ENTRY LIGHT SIGNALS AND APPROACH LIMITS

WARNING

Do not approach or attempt to enter through side hatch if communications with the crew have not been established. Death or injury can occur to rescue crew if hatch is jettisoned during rescue.

NOTE:

In the event of a loss of radio communications with ground personnel, the crew will attempt radio contact on UHF 282.8 using a PRC-112 survival radio. If crew visors are closed due to a toxic cabin environment, the astronauts will be unable to use the survival radios. If radio communications are unsuccessful, the following light signals will be displayed in the flight deck windows, day or night.

FLIGHT CREW SIGNALS TO	**GROUND CREW**
Crew Okay OMS/RCS*	Circular motion
and side hatch safed	Circular motion
APU shutdown	Circular motion
Flight crew needs assistance and will jettison side hatch	Vertical motion
Flight crew needs assistance and will not open or jettison side hatch	Horizontal motion

NOTE:

Flight crew should continue to signal until ac knowledged by ground crew. Use of binoculars may aid in signal recognition.

GROUND CREW SIGNALS TO	**FLIGHT CREW**
Acknowledgment of crew signal	3 flashes of OSC* vehicle headlights
Flight crew emergency power down and emergency egress required	Continuous flashing of OSC vehicle headlights

NOTE:

In the event that both radio and visual communications are lost, the flight crew should power down the orbiter and egress.

NOTE:

During normal shutdown procedures, certain checklist items will cause components on the orbiter to move. Examples of some of these components are: body flap, elevons, external tank (ET) doors, and engine nozzles. Visible vapors and a possible “chugging” noise may be observed/heard coming from the base of the vertical stabilizer. To familiarize yourself with the spacecraft’s external component locations,see pages OV.1 through OV.5.

SPACECRAFT APPROACH LIMITS

WARNING

Personnel are not allowed inside 200/700 feet(200 ft upwind; 700 ft downwind with winds less than 3 knots) until RJD***, side hatch safing, and drag chute safing is complete.

Exception: To respond to a declared emergency. Personnel who are required to enter inside 200/700 feet will equipped with protective clothing and self contained breathing air.

NOTE:

In the event the hazard assessment team (NASA or DOD) is unavailable or in the OSC’s judgement hazard asessment should not be atempted by DOD personnel, the flight crew should be directed to exit on emergency breathing air and be escorted by fire rescue personnel to a safe area.

Direct hazard assessment personnel to move into a position 200 feet upwind or 700 feet downwind/no-wind (winds 3 knots or less) and disembark vehicle. Always approach from the upwind position, if possible.

NOTE:

Hazard assessment personnel will have protective clothing, respiratory protection, appropriate toxic vapor detection equipment, a combustible gas detector and chocks. **Use the buddy system.**

WARNING

If toxic vapors are present, hazard assessment team will withdraw to 700 feet upwind and wait for direction from OSC. If explosive vapors are present, hazard assessment team will withdraw to 1250 feet upwind and wait for direction from the OSC.

WARNING

Personnel shall not approach the side of the orbiter main landing gear wheels closer than 60 feet until at least 45 minutes after landing. Front or rear wheel approach is 20 feet and 45 minutes. Heat buildup of tire pressure and potential burst hazard may not reach its peak until 45 minutes after roll-out. If tire has blown, extend time to one hour.

* OMS - Orbital Maneuvering System

* RCS - Reaction Control System

** OSC - On Site Commander

*** RJD - Reaction Jet Driver

SPECIAL TOOLS/EQUIPMENT
1/2 In. X 10 In. Drive Extension w/ Ratchet or Breakover Handle
3/8 In. Phillips Screwdriver
24 Ft. Ladder Heavy Hammer
Power Rescue Saw Pry Bar
#10 Torq-set Screwdriver

1. NORMAL ENTRY

a. Punch through small red tile on access cover using drive extension.
b. Insert drive extension in side hatch release socket.
c. Hit tool with heel of hand to release latch (30 lb. force required).
d. Rotate tool clockwise 1-1/4 turns.
e. Pull hatch to open.

NOTE:

Hatch weighs approximatey 300 lbs. and although hydraulically dampened, should free fall to open once over center.

2. EMERGENCY ENTRY

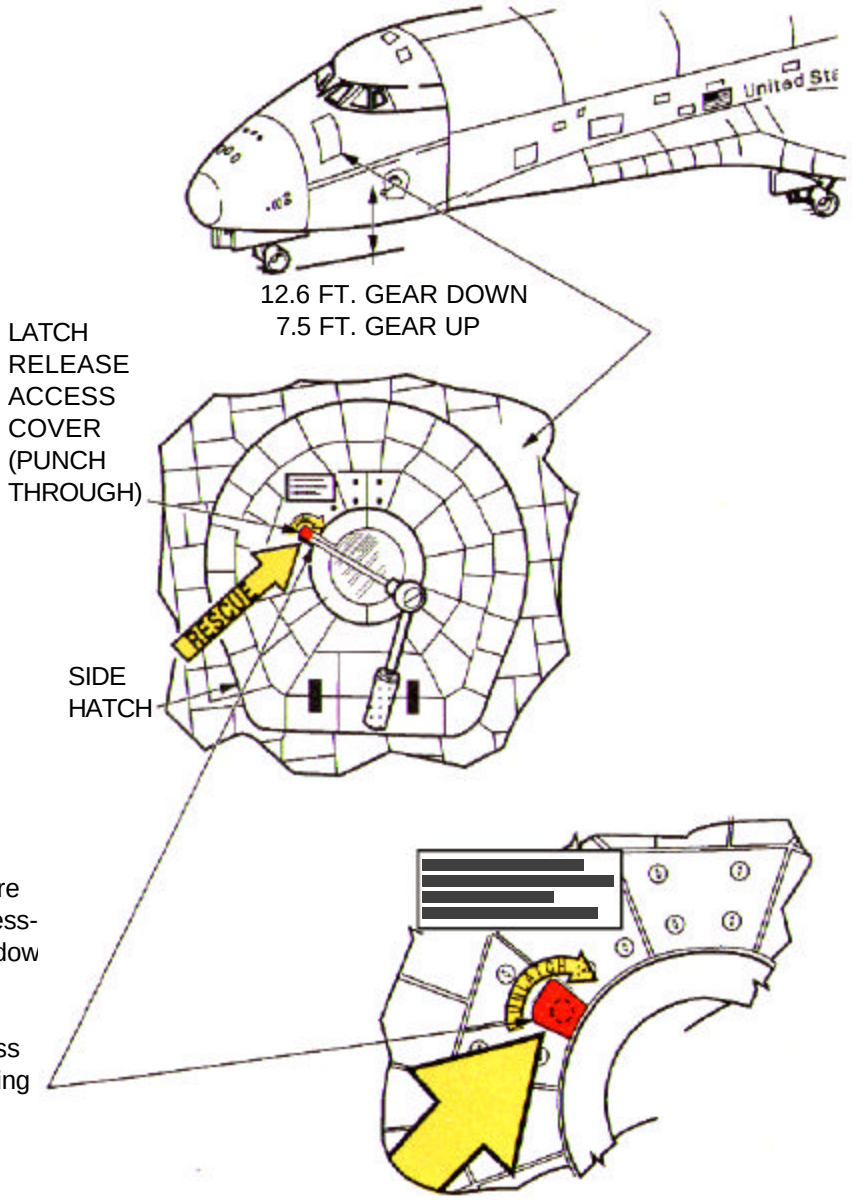
a. Using a ladder or other suitable means gain access to the emergency egress window jettison T-handle access door on lower right hand side of the fuselage. Using a #10 Torq-set screwdriver, unscrew the two Torq-set pan head screws in the upper side of the access door. Punch out the red tile above the door using the Torq-set screwdriver, depress the door release button under the tile, and open the door to expose the yellow and black striped T-handle.

WARNING

Do not punch through red tile and push release button before removal of the two screws at top of ground emergency access door. If release button is pushed, the access door will attempt to open placing pressure on the screws preventing screw removal. This action will prevent accessing the emergency T-handle and consequently emergency egress window jettison.

b. Squeeze and pull egress window T-handle to jettison emergency egress window. The T-handle pulls free within two inches after extracting a firing pin in the initiator.

c. Using a ladder or other suitable means, gain access to top of Orbiter.



ORBITER ENTRY-Continued

WARNING

Following a nominal entry, four minutes after touchdown, the thermal protection system around the overhead window area can be 120 degrees F and the overhead window glass can be 190 degrees F.

NOTE:

If the outer window broke loose from Orbiter but failed to jettison overboard, pry window loose with pry bar at forward edge, lift and toss overboard making sure no personnel are in impact area. If the outer window failed to break loose due to pyrotechnic device failure, proceed to break thermal plane with the pry bar on a heavy hammer.

NOTE:

If the inner window has closed after jettison operation, apply pressure with a pry bar at forward end of window to open and allow internal and external pressures to equalize, then manually push window down to full-open position or use penetrator nozzle tool to penetrated window near aft outboard corner to allow pressures to equalize, then manually push window down to full-open position. If pyrotechnic device failed, proceed to break both panes of the window.

d. Enter aft flight deck through egress window opening.

e. Immediately verify that all crewmembers have their helmet face-plates closed and all emergency oxygen bottles are turned on.

f. Access conditions for fire or debris in the Command Module. If fire or smoke is evident, activate fire suppression system and/or use portable fire extinguishers as required.

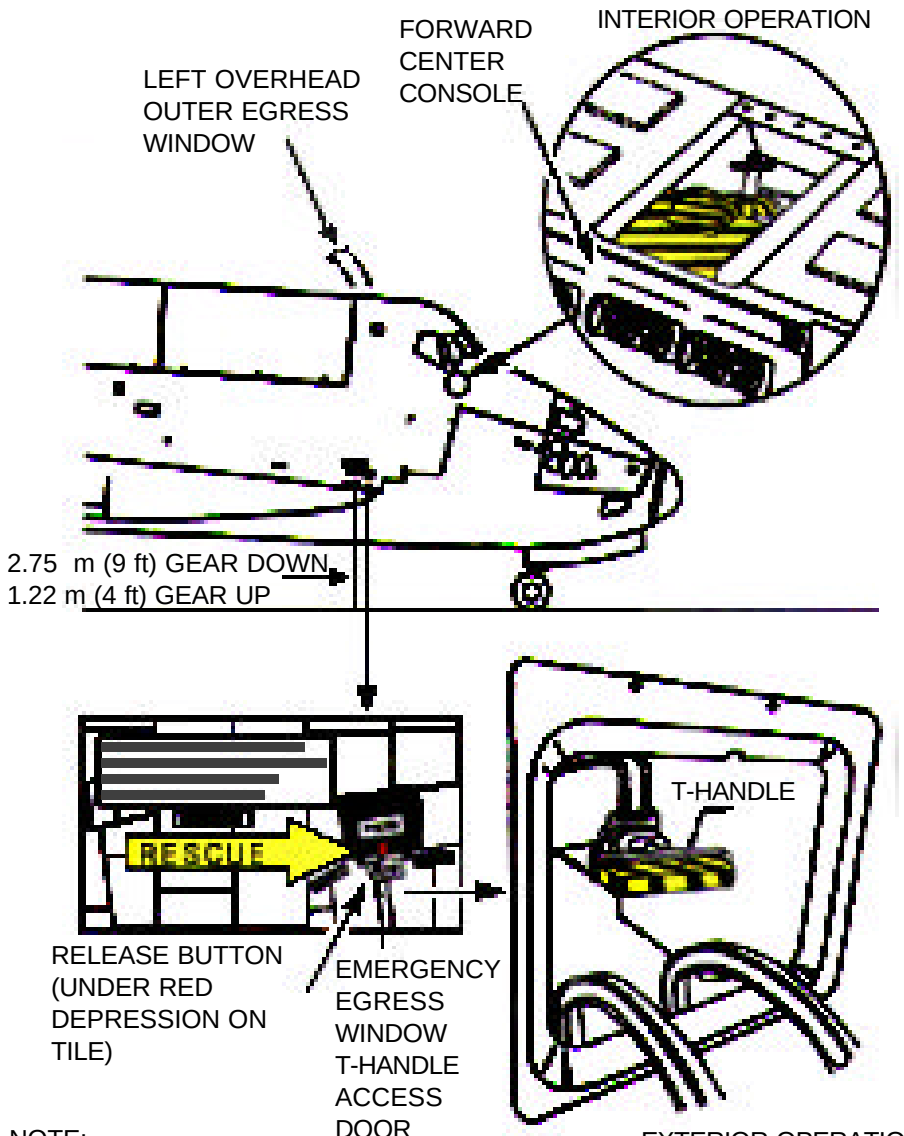
NOTE:

Orbiter power must be available to activate the fire suppression system.

g. Powerdown orbiter electrical systems. See Emergency Powerdown Procedures on page OV.38.

NOTE:

The safing pin and cover have to be removed to expose the R-handle flexible ring.



NOTE:

T-handle pulls free of initiator assembly when squeezed and pulled.

ORBITER ENTRY-Continued

3. CUT-IN

NOTE:

- When ever possible, rescue operations should be accomplished through the side hatch or emergency egress window. Cut-in shall only be considered as a last resort.

- Forward fuselage made up of an outer structure and a crew module structure. The outer structure is conventional skin and stringer contruction covered with thermal protective tile. The crew module structure is a welded pressure vessel.

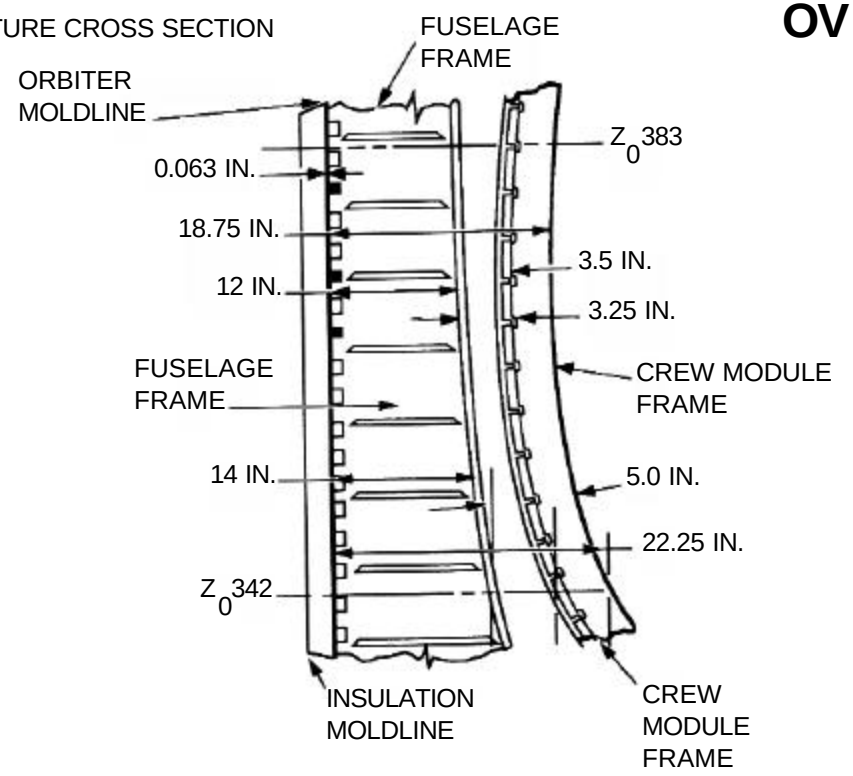
a. Cut through outer structure, as marked.

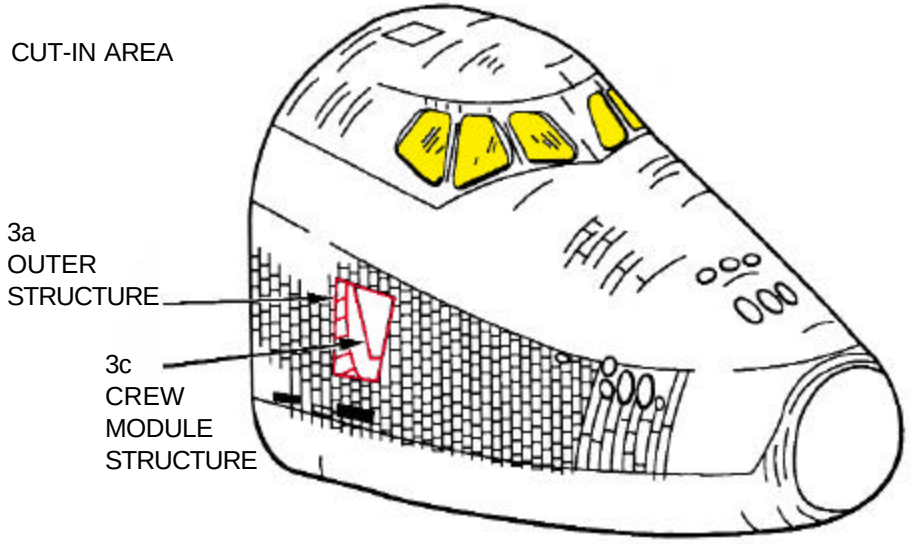
b. Remove panel.

c. Cut through crew module structure.

d. Remove panel.

STRUCTURE CROSS SECTION

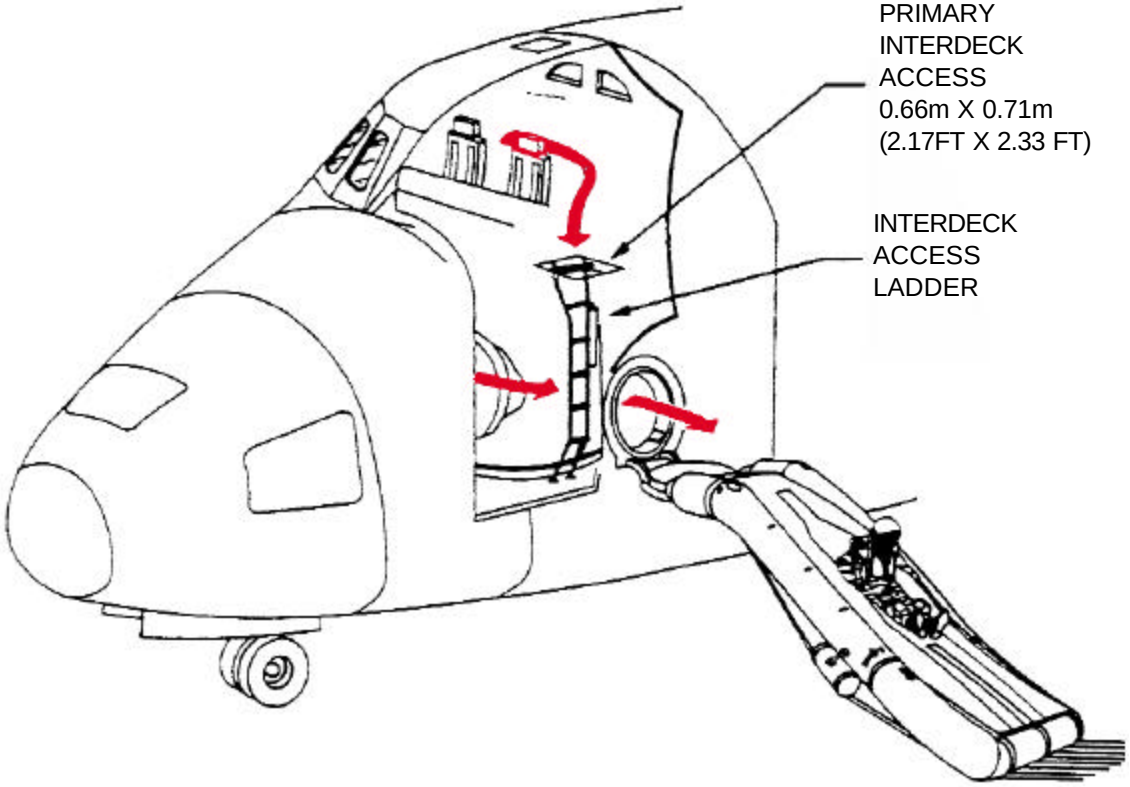


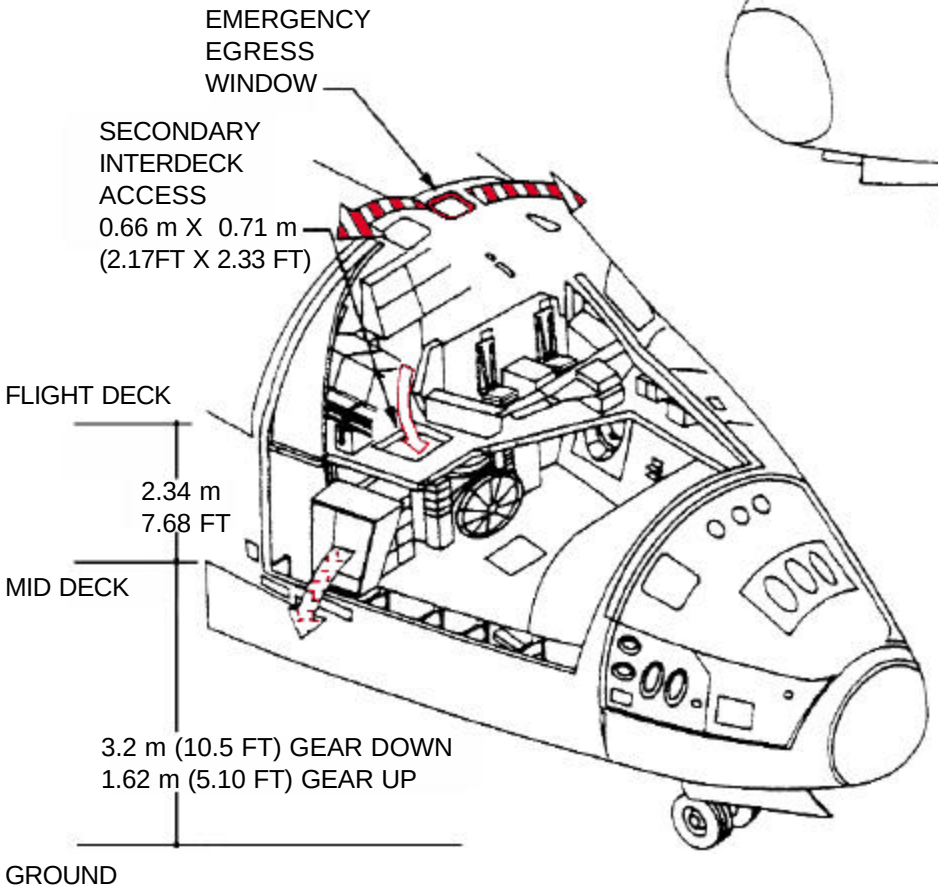


CREW ESCAPE ROUTES

LEGEND

- SIDE HATCH (PRIMARY ROUTE)
- EMERGENCY EGRESS WINDOW (SECONDARY ROUTE)
- CUT-IN AREA (NOT RECOMMENDED)
- SECONDARY INTERDECK ACCESS





INTERIOR OPERATION OF SIDE HATCH

1. SIDE HATCH INTERIOR OPERATION

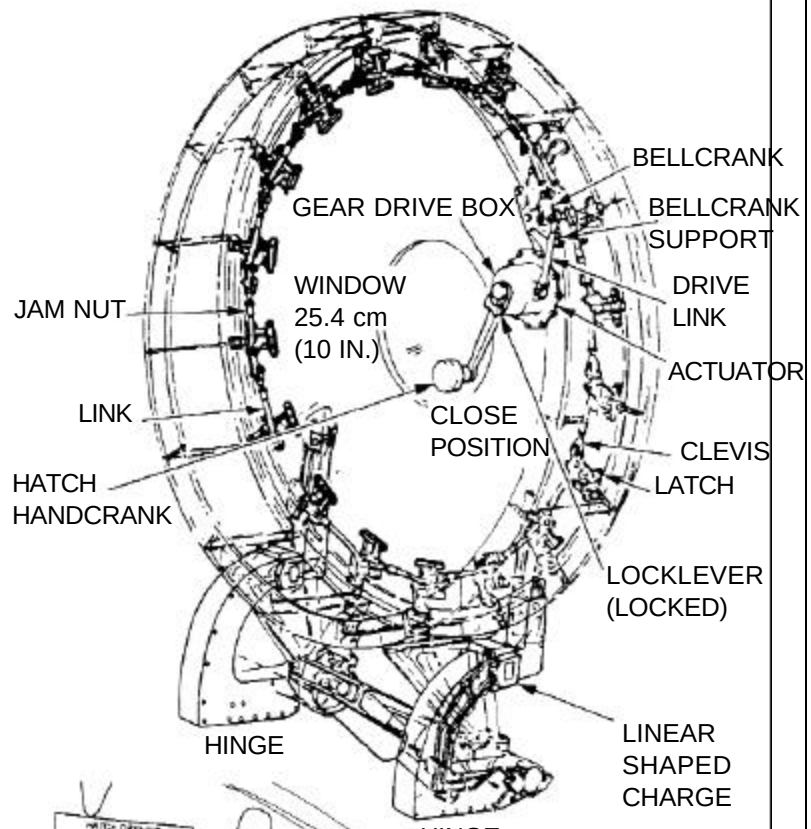
a. Flip locklever on side hatch crank to the UNLOCK position (180^0).

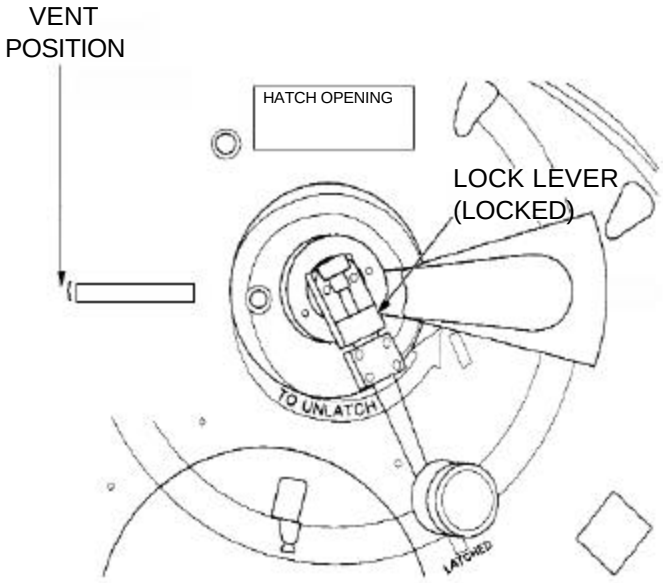
b. Rotate hatch handcrank counterclockwise (CCW) to vent detent and wait approximately 30 seconds (worst case) for pressures to equalize.

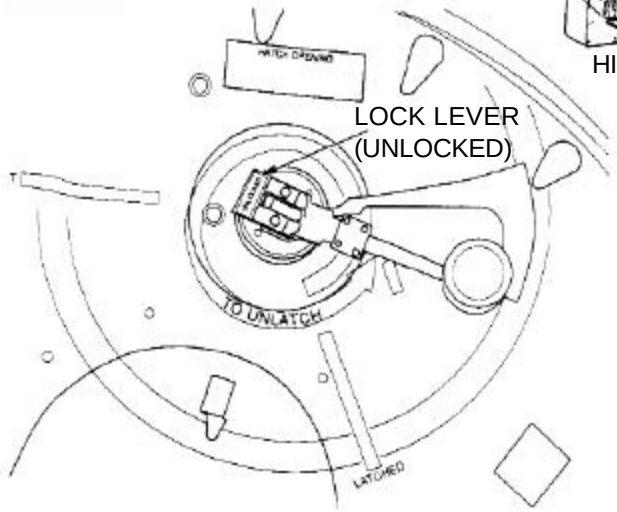
NOTE:
Time to equalize will vary depending upon altitude of landing site.

c. Rotate hatch handcrank to unlatch position (hard stop).

d. Push upper end of hatch outward and allow to free fall to full open position.







EMERGENCY EGRESS-SIDE HATCH JETTISON SYSTEM

2. SIDE HATCH JETTISON - INTERNAL OPERATION

WARNING

Firefighers/rescue crew should be advised by the flight crew of their intent to jettison the side hatch by the ground communications network. Ground personnel must be out of danger area before hatch is jettisoned.

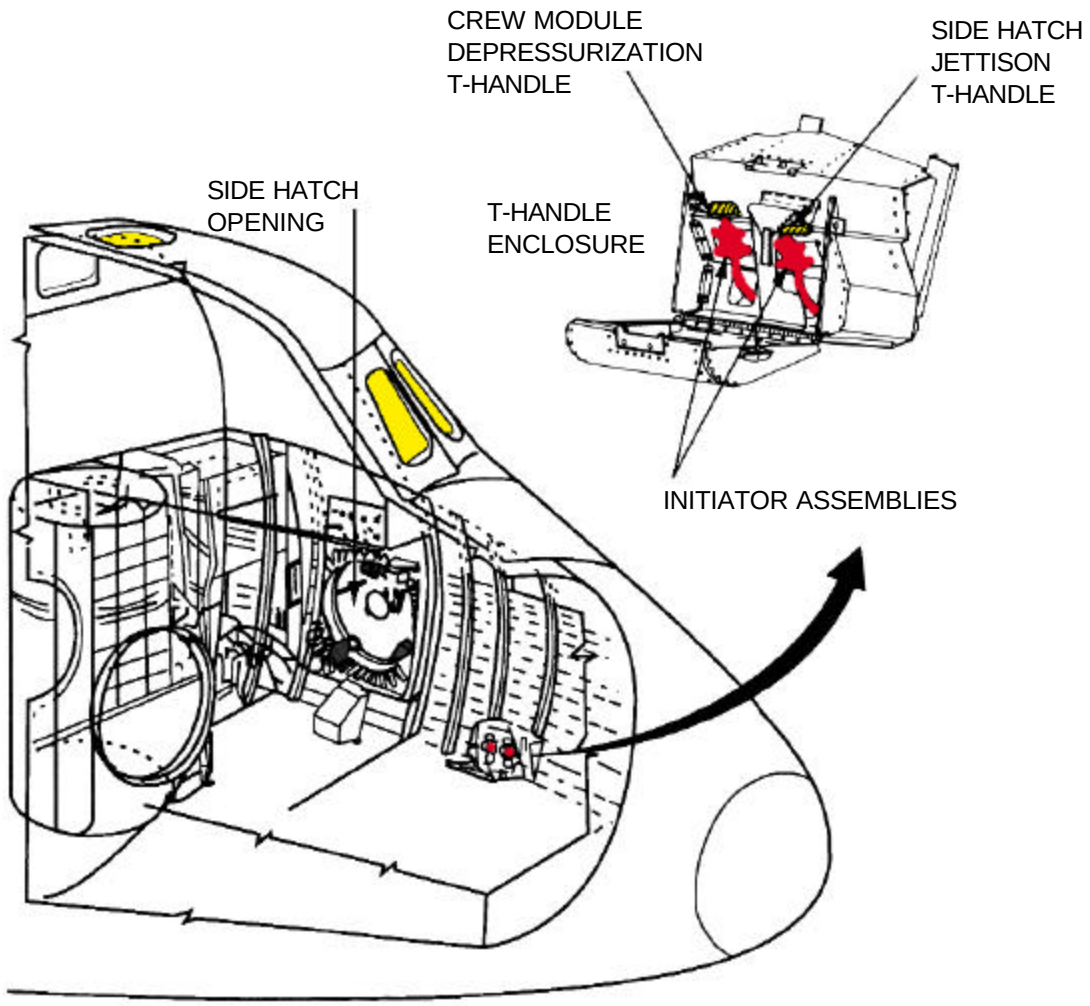
The flight crew will:

a. Open T-handle enclosure by squeezing knobs together located on top of enclosure.
b. Open fabric protective cover covering forward T-handle.
c. Squeeze and pull up on forward (right hand) yellow and black striped T-handle to jettison hatch.
d. After hatch has been jettisoned, remove emergency egress slide cover and place it away from the side hatch area.
e. Lift lower slide support and slide pack until intermediate hinges lock in place. Slide pack will be level with floor.
f. Lift and rotate slide pack and slide support assembly until complete assembly is lying in the hatch tunnel.
g. Flip slide pack outward over the left side.
h. Pull up on actuation handle on the slide pack to deploy and inflate the emergency egress slide.
i. After the slide is fully inflated, sit down on slide support structure in the hatch tunnel and push away from the slide support structure.

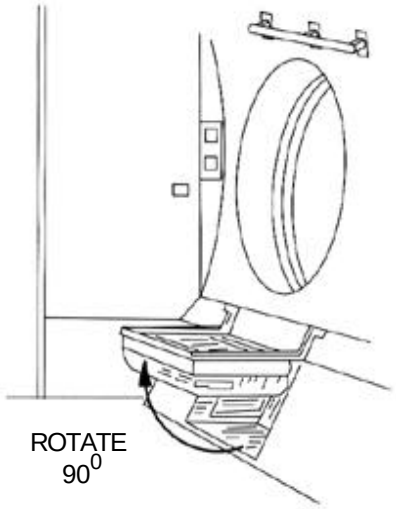
WARNING

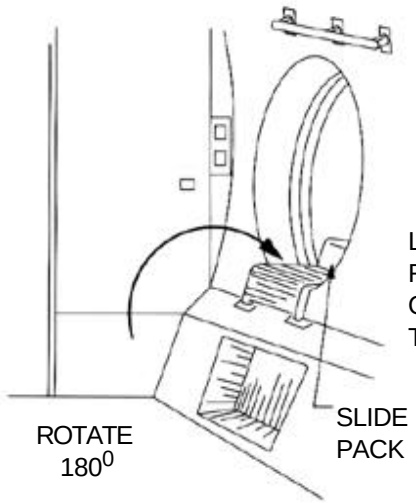
No more than two crewmembers shall be on the slide at any time.

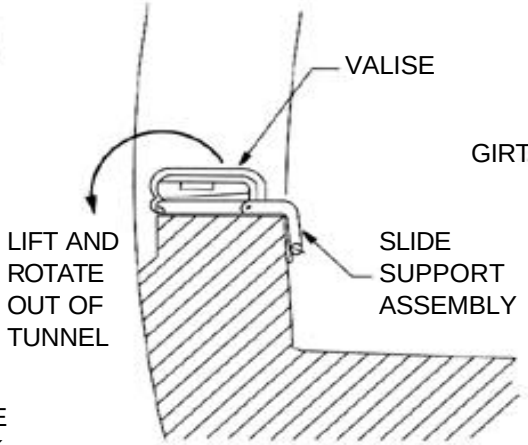
j. At the bottom of slide, jump to feet immediately, run upwind to a safe area before removing helmet.

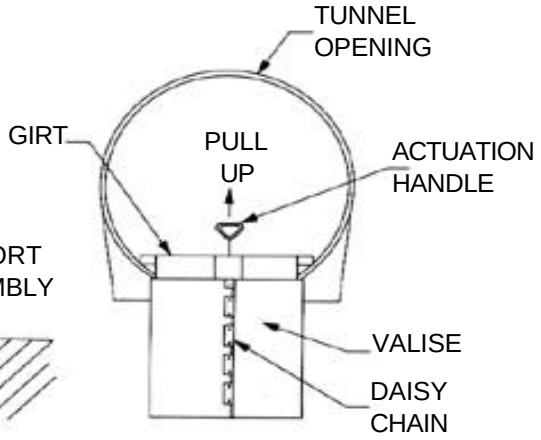


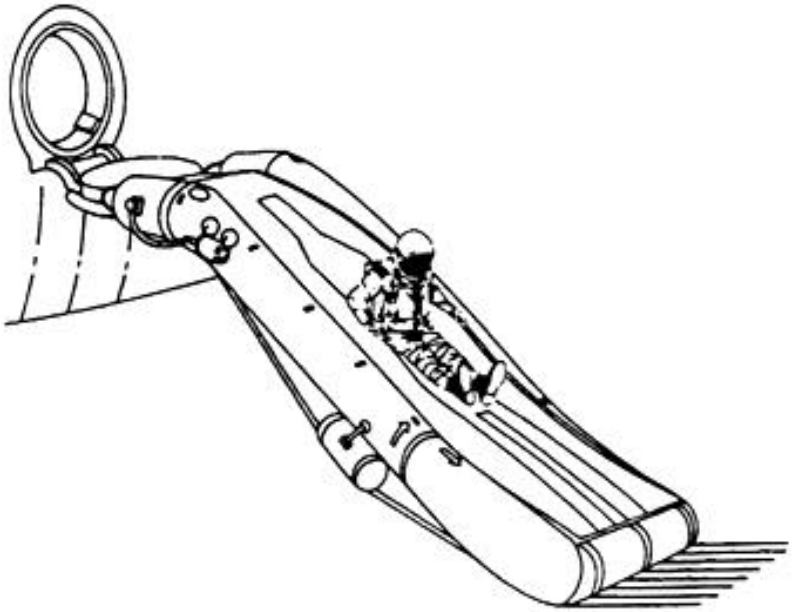
EMERGENCY EGRESS SLIDE SYSTEM



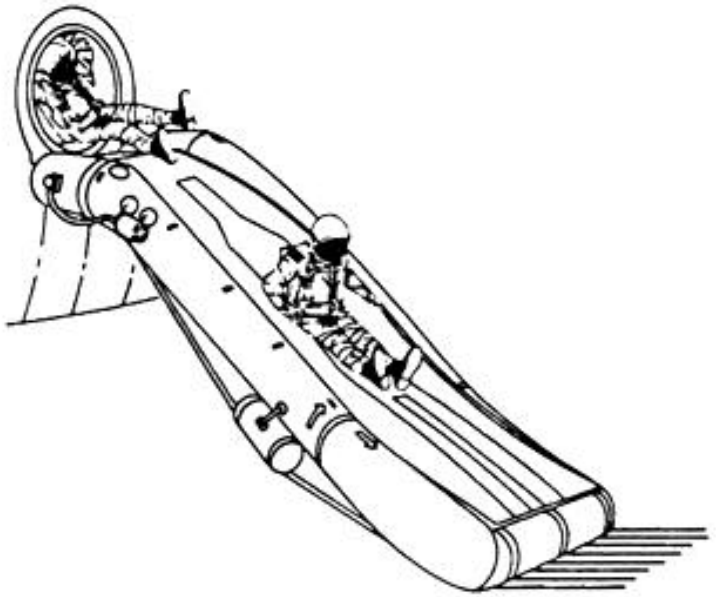








NON-EMERGENCY UNASSISTED EGRESS
WITH SIDE HATCH FULLY OPENED



EMERGENCY EGRESS SLIDE
WITH SIDE HATCH JETTISONED

EMERGENCY EGRESS SLIDE SYSTEM
MANUAL DEPLOYMENT

3. MANUAL SLIDE DEPLOYMENT-INTERNAL OPERATION

a. Flip locklever on side hatch crank to the UNLOCK position (180 degrees).

b. Rotate hatch crank counterclockwise to the VENT detent. Wait 30 seconds (worst case) for pressure to equalize.

NOTE:
Time to equalize will vary depending upon altitude of landing site.

c. Remove emergency egress slide cover and set it away from the side hatch area.

d. Lift lower slide support and slide pack until intermediate hinges lock in place. Slide pack will be level with floor.

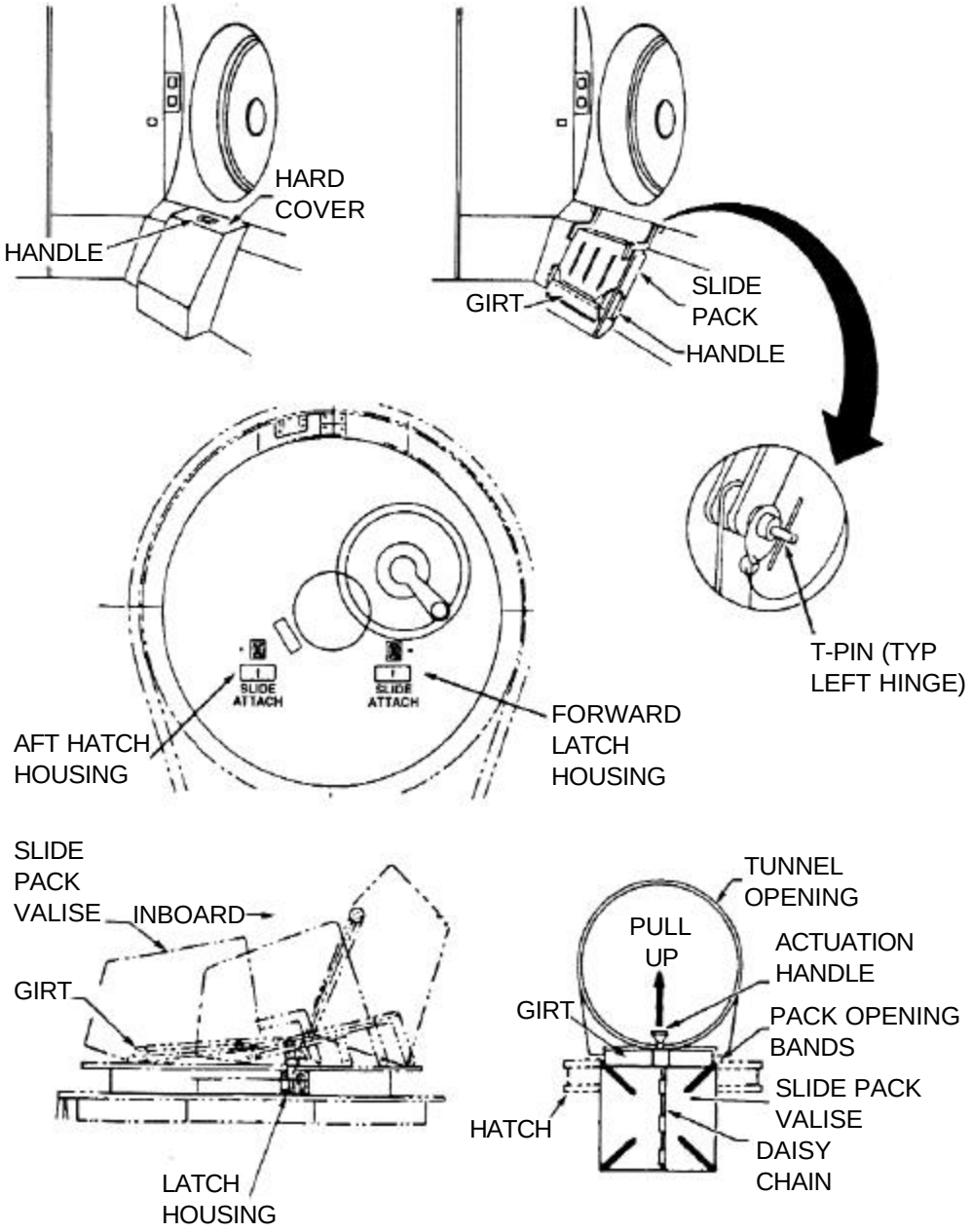
e. Remove strap from upper slide support assembly.

f. Rotate entire slide support assembly and slide pack upward 180 degrees into the side hatch tunnel.

g. Position slide pack squarely on lower slide support assembly and secure by wrapping the strap around the slide pack and lower slide support assembly.

h. Remove entire slide support assembly and slide pack from the orbiter sidewall by pulling the tethered T-pins from hinge brackets.

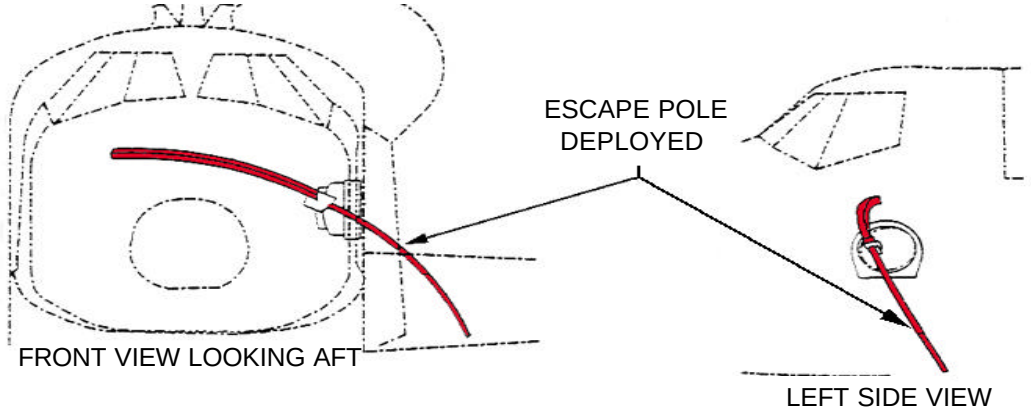
i. Lift slide support assembly and slide pack from the side hatch tunnel and rotate back 90 degrees to the vertical.

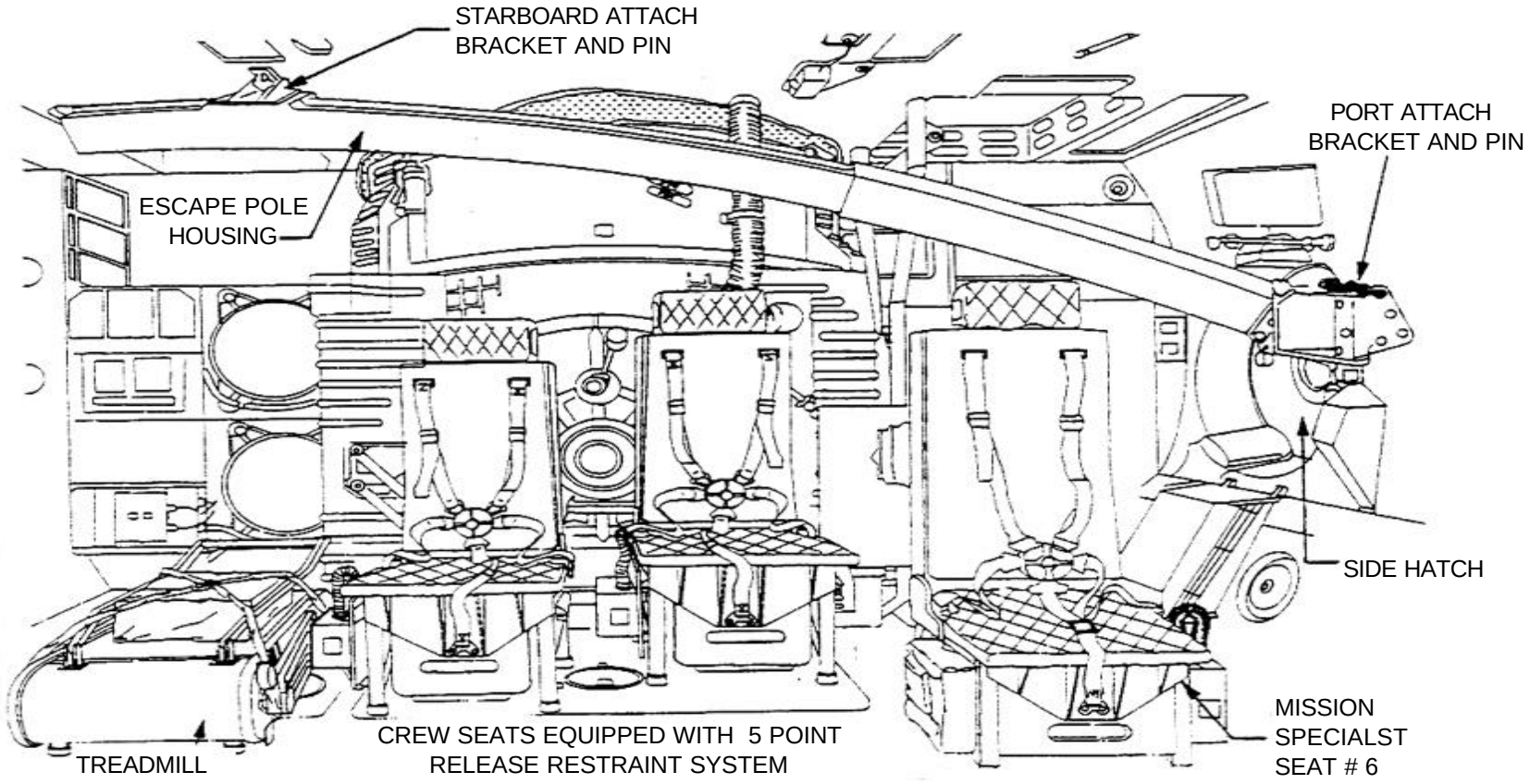


POLE CREW ESCAPE SYSTEM

NOTE:

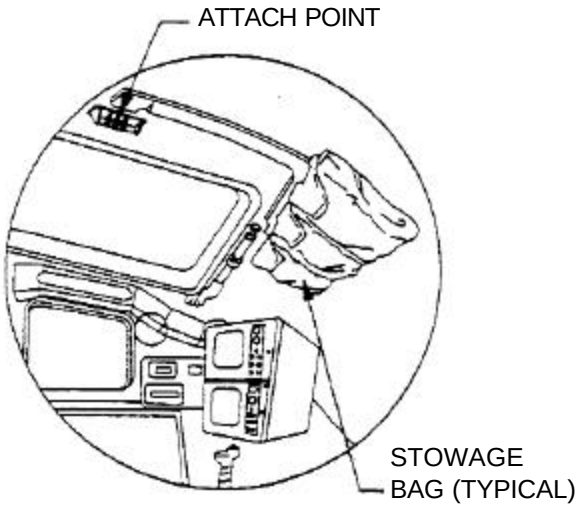
The pole crew escape system is used during a controlled glide flight, not during ground egress. Graphics depict Orbiter configuration if this type of egress was used and what to expect. Entry through the side hatch will be obstructed by the deployed pole.



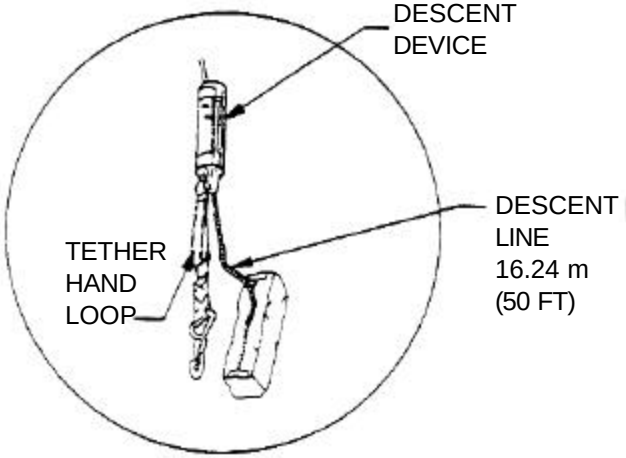


VIEW LOOKING AFT
LOWER CREW COMPARTMENT

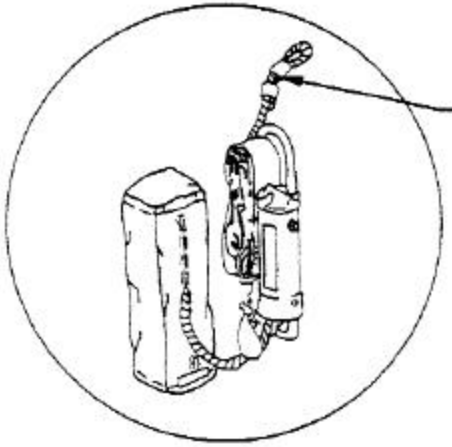
GROUND DESCENT DEVICES



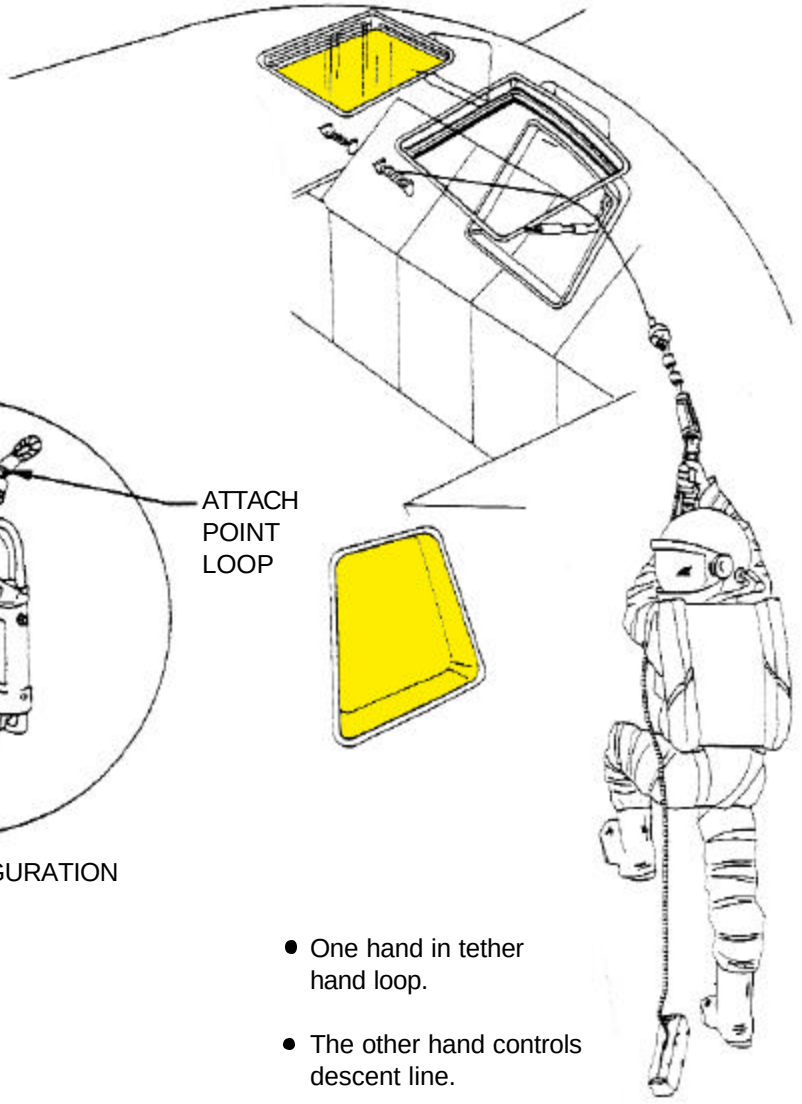
FIXED INSTALLATION



DEPLOYED CONFIGURATION

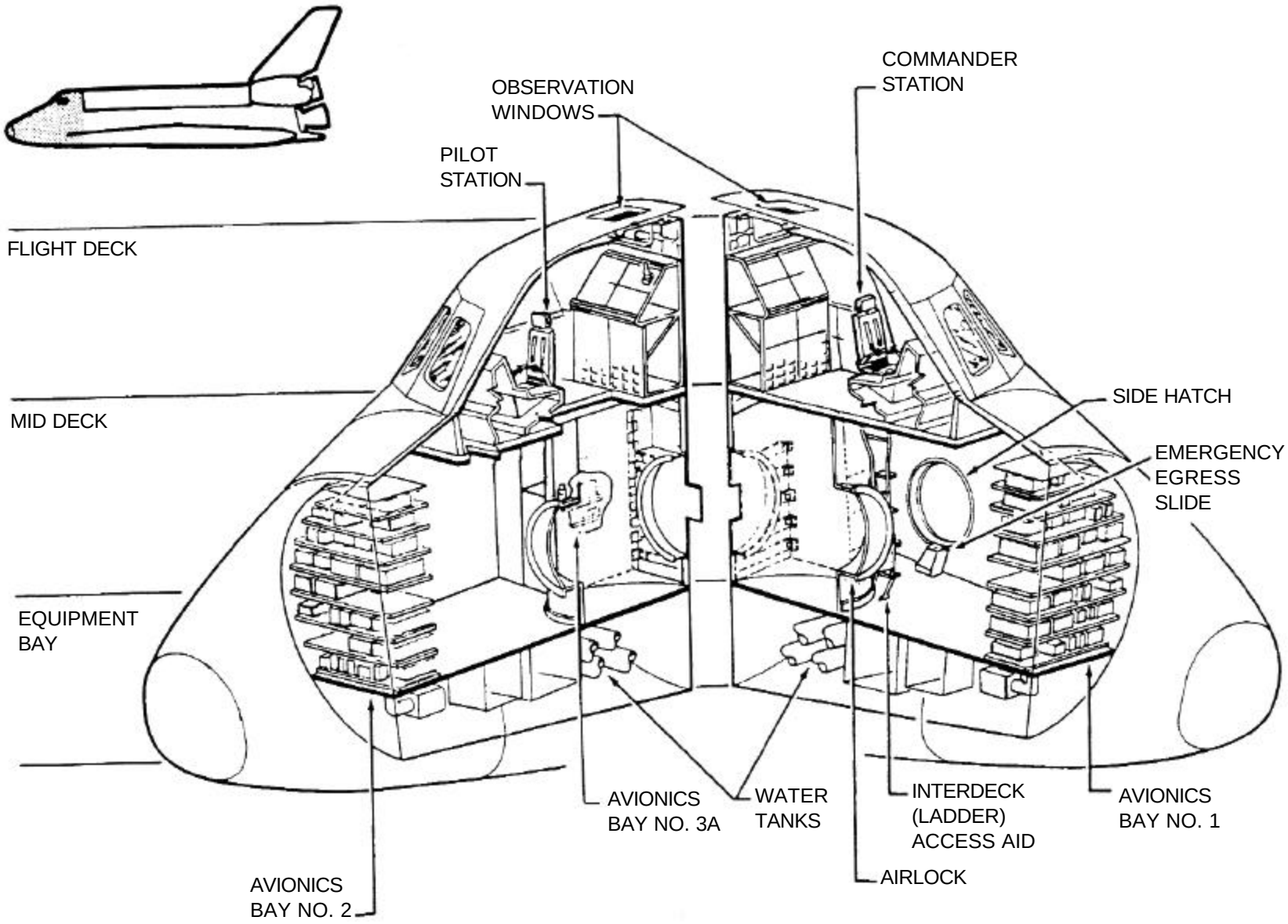


STOWED CONFIGURATION

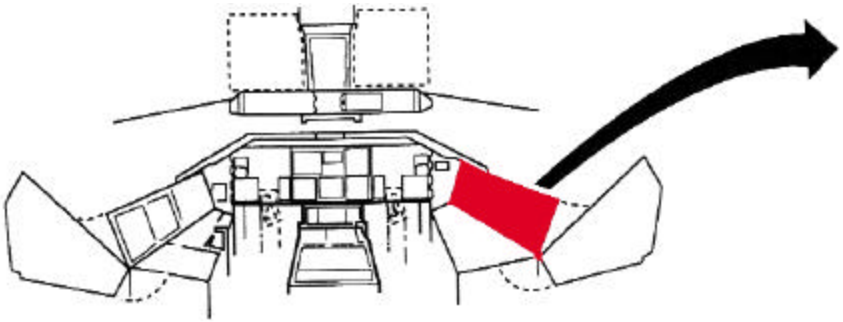


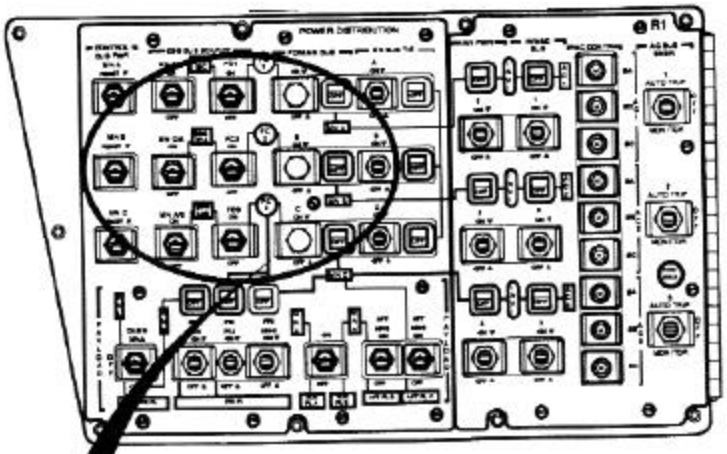
- One hand in tether hand loop.
- The other hand controls descent line.
- Tether attaches to carabiner on harness.

CREW MODULE ARRANGEMENT



EMERGENCY POWERDOWN





1. EMERGENCY POWERDOWN PROCEDURES

WARNING

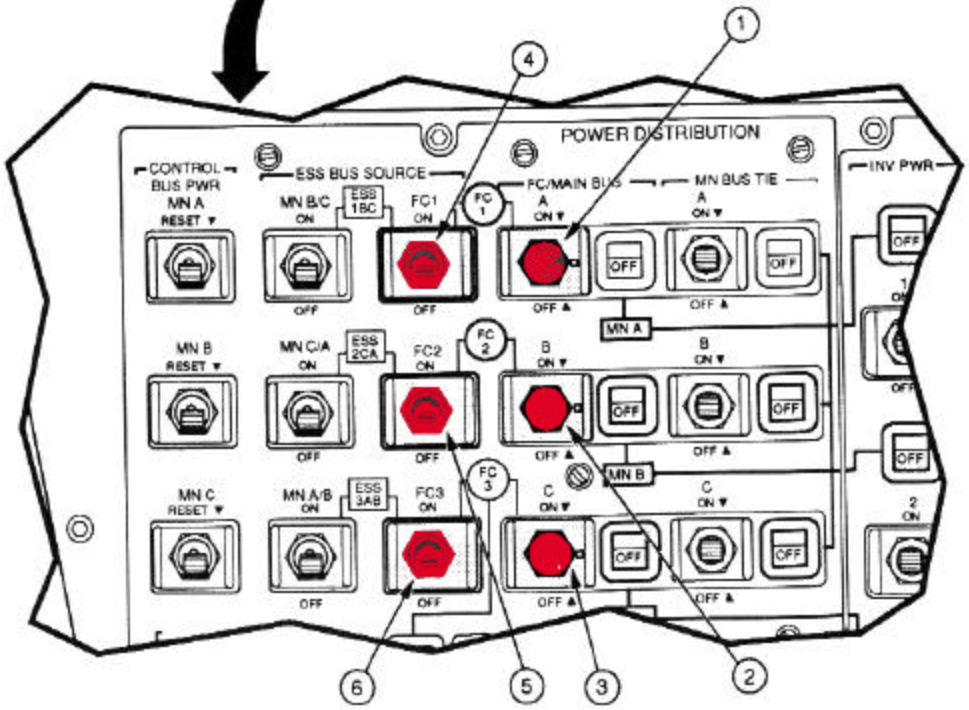
Do not deviate from these procedures. Positioning of any other switches/circuit breakers other than those specified here may jepardize the safety of the flightcrew and rescue personnel.

a. On POWER DISTRIBUTION PANEL R1, position switches to OFF in the numbered sequence shown (ball numbers), holding the first three leverlock switches (FC/MAIN BUS switches A, B, and C in OFF position for two seconds.

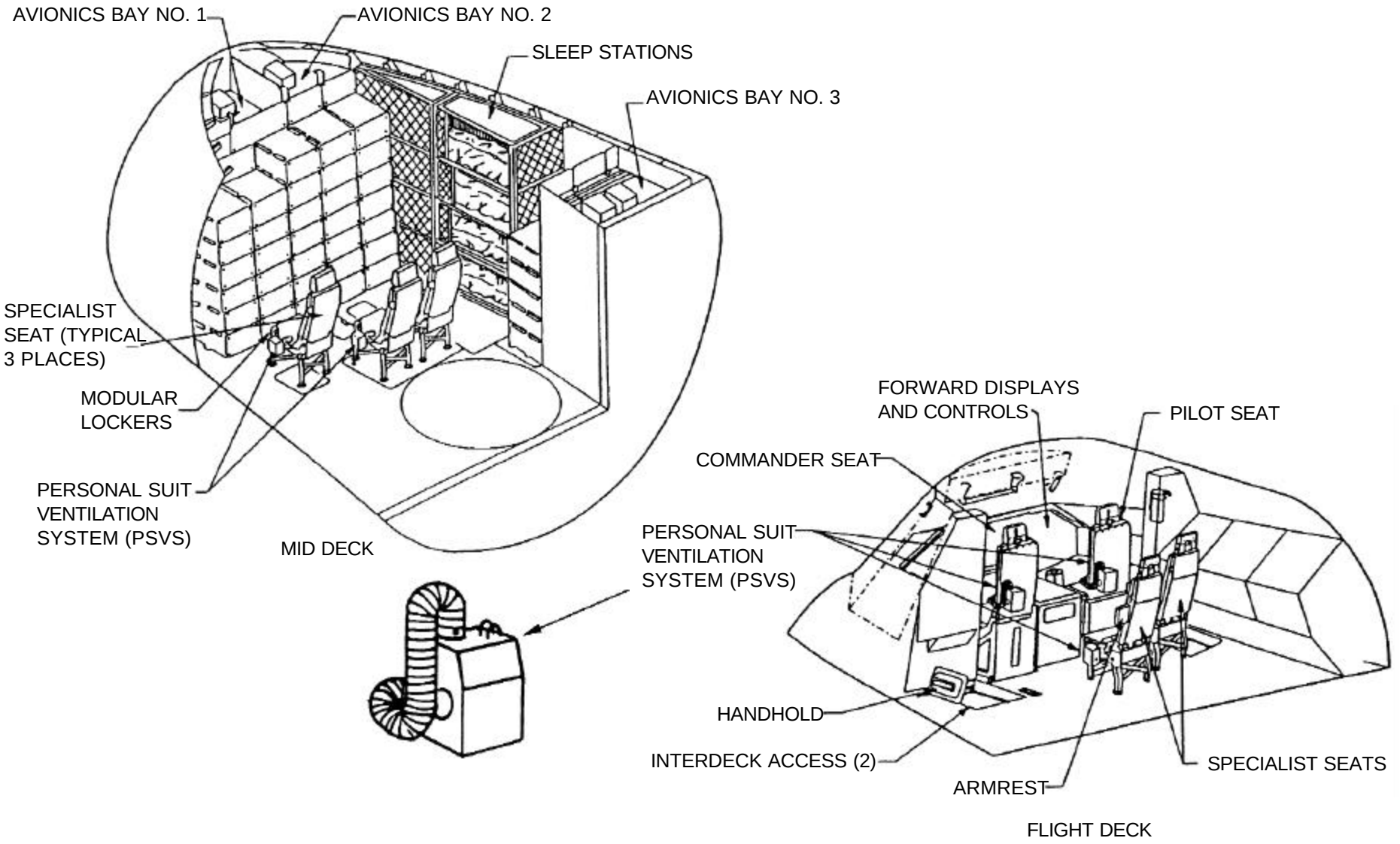
NOTE:

Leverlock switches must be pulled to release locking mechanism.

b. Verify indicators to the right of the switches read OFF.



CREW SEAT LOCATIONS



LANDING EMERGENCY EGRESS MODES

NOTE:
Crash/rescue personnel assigned to Orbiter landing operations should be familiar with landing emergency modes. On missions longer than 30 days, crew-members will need assistance in removing themselves from the Orbiter. Use **modes V and VII** for these occasions as well as emergencies where crew members are incapacitated.

MODE I-UNAIDED EGRESS FROM THE LAUNCH PAD
Flight crew egresses the orbiter and uses the slidewire system to escape from the launch pad.

MODE II-AIDED EGRESS FROM THE LAUNCH PAD
Close out crew assists the flight crew in egressing from the orbiter. The slidewire system is used to escape from the launch pad.

MODE III-AIDED EGRESS FROM THE LAUNCH PAD
Fire/crash/rescue crew assists the flight crew in egressing from the orbiter. The slidewire system is used to escape from the launch pad.

MODE IV-AIDED EGRESS FROM THE LAUNCH PAD
Fire/crash/rescue crew assists both flight crew and closeout crew in egressing from the orbiter. The slidewire system is used to escape from the launch pad.

MODE V-UNAIDED EGRESS/AIDED ESCAPE
A Mode V egress/escape is when the flight grew members are able to egress unaided from the orbiter with aided escape, as required to a safe area away from the orbiter by crash/rescue personnel. A Mode V emergency egress may be initiated by the flight crew, the Landing Convoy Commander, or the Flight Director.

MODE VI - AIDED EGRESS/ESCAPE ON OR NEAR RUNWAY
A Mode VI egress/escape follows an Orbiter landing mishap on or near a runway readily accessible by prepositioned landing convoy ground personnel. The crash/rescue personnel will respond to the emergency in accordance with preplanned fire/rescue procedures and will aid the flight crew to egress or rescue them from the Orbiter. Crash/rescue personnel will transport the flight crew away from the Orbiter to the decontamination area. Following decontamination, they will be transported by medical personnel to the triage area for medical evaluation/ treatment and for transportation, if required, to the NASA designated medical care facility. A Mode VI emergency may be initiated by either a flight crew member, the Landing Convoy Commander, or the Flight Director.

MODE VII - AIDED EGRESS/ESCAPE IN REMOTE AREA (CONUS ONLY)
A Mode VII emergency is a landing mishap off a runway within a 25-mile radius of the landing site designated as an off-site contingency operation (OSCO). The site is not easily accessible by fire apparatus and crash/rescue personnel. Transport and medevac helicopters will relocate to the ground convoy positioned near the runway, pick up the required personnel and equipment, and proceed to the crash site. The helicopters will land approximately 200 feet upwind of the Orbiter, if possible, and disembark the crash/ rescue personnel and flight surgeons. The senior fire officer, or his designee, becomes the on-scene commander of the rescue effort. The crash/rescue personnel respond immediately to the situation with rescue of the flight crew being the primary effort. They will assist in loading the flight crew into the medevac helicopters for transport to the NASA designated medical care facility.

MODE VIII – BAILOUT OF THE FLIGHT CREW FROM THE ORBITER DURING CONTROLLED GLIDING FLIGHT
A Mode VIII emergency egress/escape will be ordered anytime an Orbiter cannot reach a suitable landing site with possible loss of the flight crew. Bailout would commence at approximately 25,000 feet while in controlled gliding flight. The flight crew CDR will make the final decision for bailout. Crash/rescue crews, if notified to prepare for, should be in the approximate area of flight crew touch down. They will assist in loading the flight crew into the medevac helicopters for transport to the NASA designated medical care facility.

EXTRACTION OF INCAPACITATED CREWMEMBERS FROM THEIR SEATS

Since all flight crewmembers are trained for an unaided emergency egress from the Orbiter in case of a landing mishap, only aided egress by rescue personnel will be addressed in the following procedure. These procedures assume that electrical power is still ON inside the Orbiter and the rescue personnel are able to gain entry into the crew module (CM) shortly after the landing mishap, either through the side hatch or the emergency egress window. If there are six or more crewmembers, the specialist in seat S6 on the mid-deck (page 7-40) will be the first crewmember removed from the CM if aided emergency egress is through the side hatch. However, if aided emergency egress is through the emergency egress window, the specialist seated in seat S4 on the flight deck will be rescued first. These actions clear the path to the point of egress.

After gaining entry into the CM the first rescue person on the flight deck and the mid-deck shall initially check on each crewmember's breathing oxygen supply in the following manner:

1. Make sure each crewmember's helmet is securely locked into the neckring, the faceplate is closed, and the bailor bar is pulled down and latched.

WARNING

Since toxic vapors may be present, do not open faceplate or remove helmet from crewmember until clear of Orbiter and any toxic vapors.

2. If the "green apple" on each crewmwmber's emergency oxygen supply has not been pulled, pull it to provide emergency oxygen to the crewmember. If the "green apple" has been pulled previously by the crewmember, disconnect the Orbiter oxygen hose from the LES oxygen manifold and connect an emergency breathing air pack to it, since it is not known how long the crewmember has been on emergency oxygen.

WARNING

- Emergency oxygen bottles, contain a 10 minute supply under normal sea level conditions.

- Anti-g suit controller valve locking clip must be pulled prior to connecting emergency breathing air hose to oxygen manifold to prevent loss of air into the anti-g suit.

3. Verify the emergency breathing air pack is turned on to provide breathing air to the crewmember.

4. Verify oxygen manifold valve on left leg is ON whenever an emergency breathing air pack is connected to the oxygen manifold.

NOTE:

Cabin air is 100 psi and will override bailout bottle emergency air which is 70 psi.

EXTRACTION OF INCAPACITATED CREWMEMBERS FROM THEIR SEATS-Continued

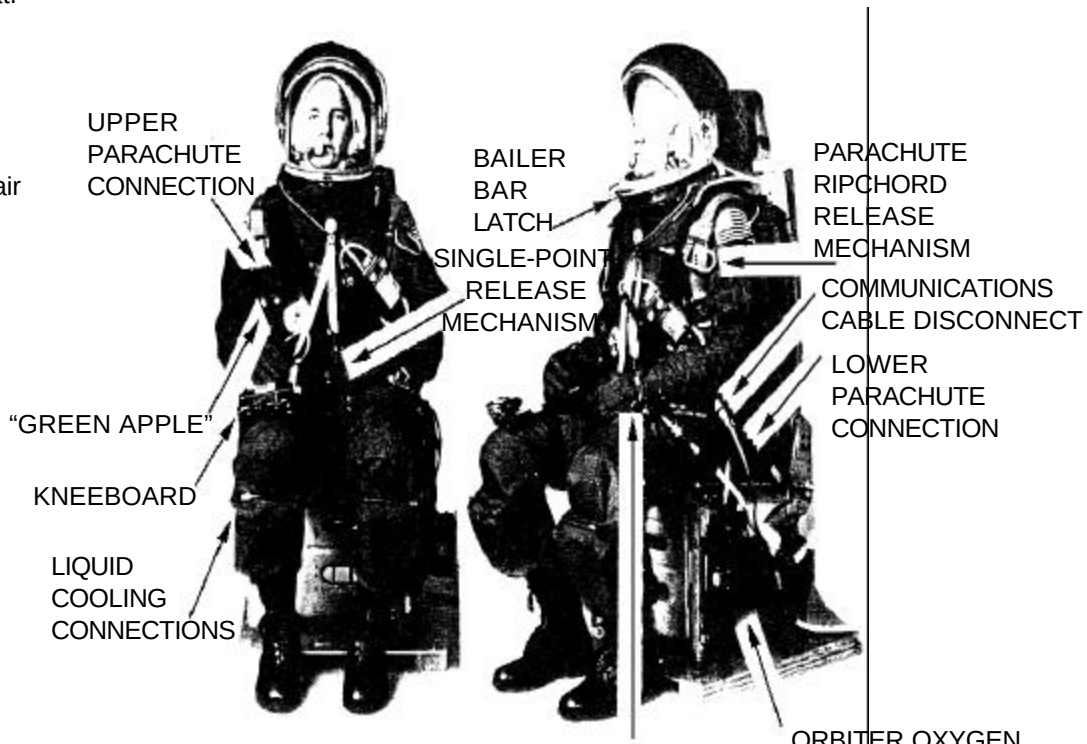
5. Remove and discard kneeboard.
6. Release single-point release mechanism by turning the “star” buckle in either direction, and toss shoulder straps over back of seat.
7. Disconnect lower parachute connections.
8. Disconnect upper parachute connections and toss over back of seat.
9. Disconnect communications cable leads.
10. Disconnect liquid cooling at suit connections.
11. Disconnect Orbiter oxygen hose from oxygen manifold on leg.
12. Pull G suit pin (preventing bailout air from going into the G suit) and attach emergency breathing air pack on carabiner on harness, if air pack is used. Turn manifold ON.
13. Place wrist strap around wrists.
14. Place leg strap around legs at ankles.
15. Extract crewmember from crew module (CM)

CREWMWMBER EXTRACTION – SHORT VERSION

NOTE:

Issue sufficient air supply. Be prepared for some entanglement.

1. Lower clear faceshield, not sun visor, and verify helmet faceplate is closed and bailer bar is latched down. If faceplate is not locked down, it will rise. If the faceplate will not lock down, lower both the clear faceplate and sun visor.
2. If emergency oxygen bottles have not been turned on, pull the “green apple” on flight suit harness and disconnect Orbiter oxygen hose from O_2 manifold on left leg.
3. If “green apple” has been pulled, disconnect Orbiter O_2 hose and connect emergency breathing air pack hose to suit O_2 manifold.
4. Disconnect lower parachute connections.
5. Disconnect upper parachute connections and toss over back of seat.
6. Hang emergency breathing air pack on carabiner on harness, if air pack is used.



SPECIALIST SEAT SHOWN

EXTRACTION OF INCAPACITATED CREWMEMBERS FROM THEIR RECUMBENT SEATS

NOTE:

Recumbent seats are used on long mission flights 30 days or more. Seats are mounted horizontally. Crewmembers will need aided egress/escape. Seat positions affected are seats 6, 7, and 8. One or all seats may be configured.

NOTE:

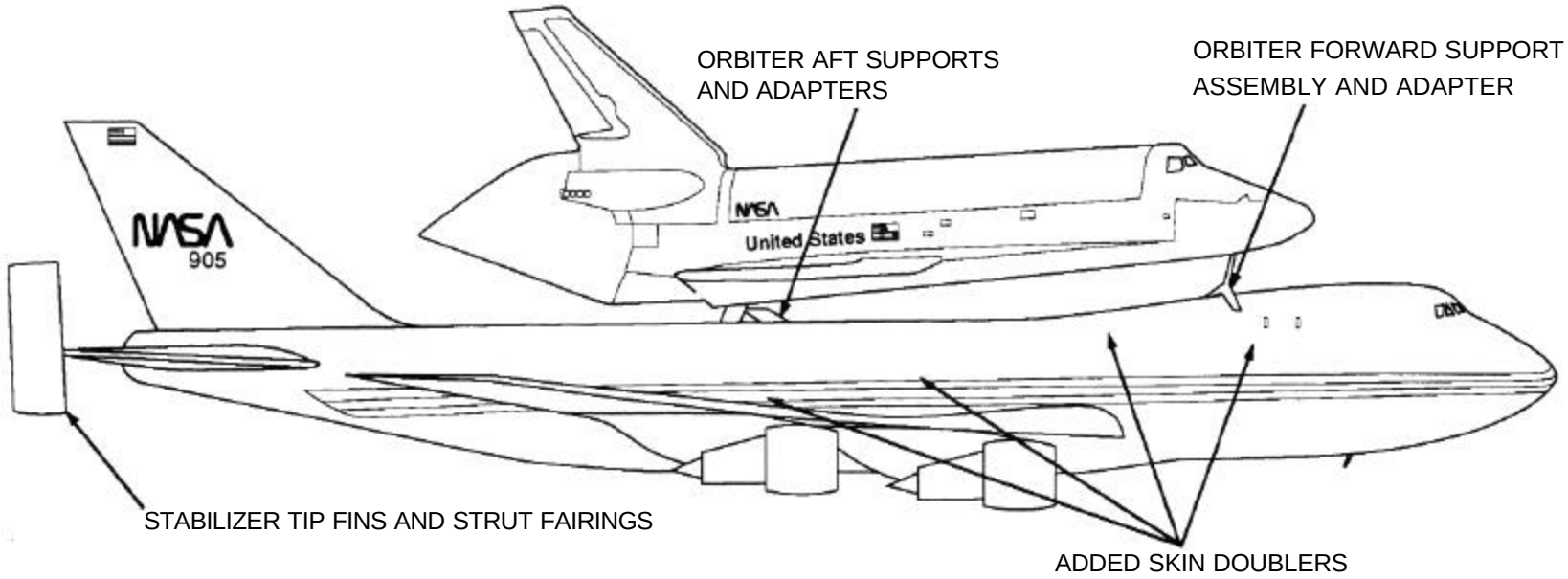
Orbiter crews are converting to ACES II flight suits. These are the same suits used on aircraft incorporating ACES II ejection seats, i.e.; A-10, B-1, B-2, F-15, F-16, F-22 and F-117. Refer to those sections for locations of suit disconnects for successful extraction.

ORBITER CARRIER (OC) INFORMATION

747-200B AIRFRAME

NOTE:

- All passengers seating and galley provisions removed aft of no. 1 doors
- Added bulkheads
- Modified adjacent frames
- Increased skin gage
- Revised tip ribs
- Added tip fin attach fingers
- Wheels equipped with fusible plugs
- Added skin doublers



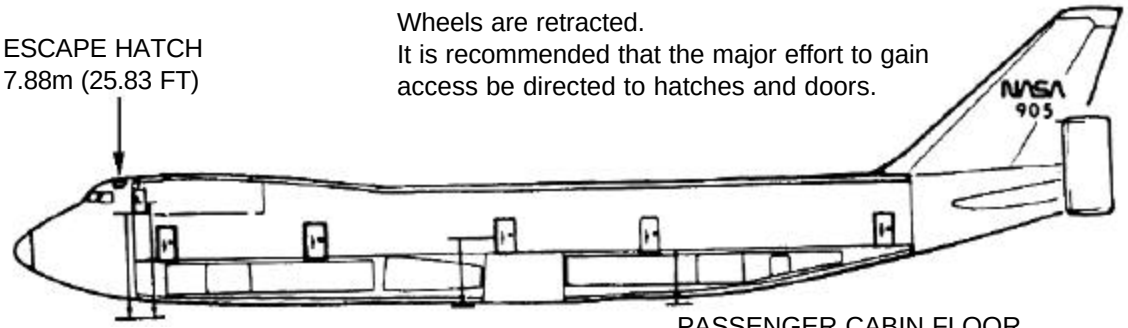
ORBITER CARRIER DIMENSIONS

WEIGHTS (MATED)
MAXIMUM TAXI GROSS WEIGHT: 323,410 kg
(713,000 LB)
DESIGN LANDING WEIGHT: 272,154 kg
(600.000 LB)

NOTE:
Wheels are retracted.
It is recommended that the major effort to gain access be directed to hatches and doors.

ESCAPE HATCH
7.88m (25.83 FT)

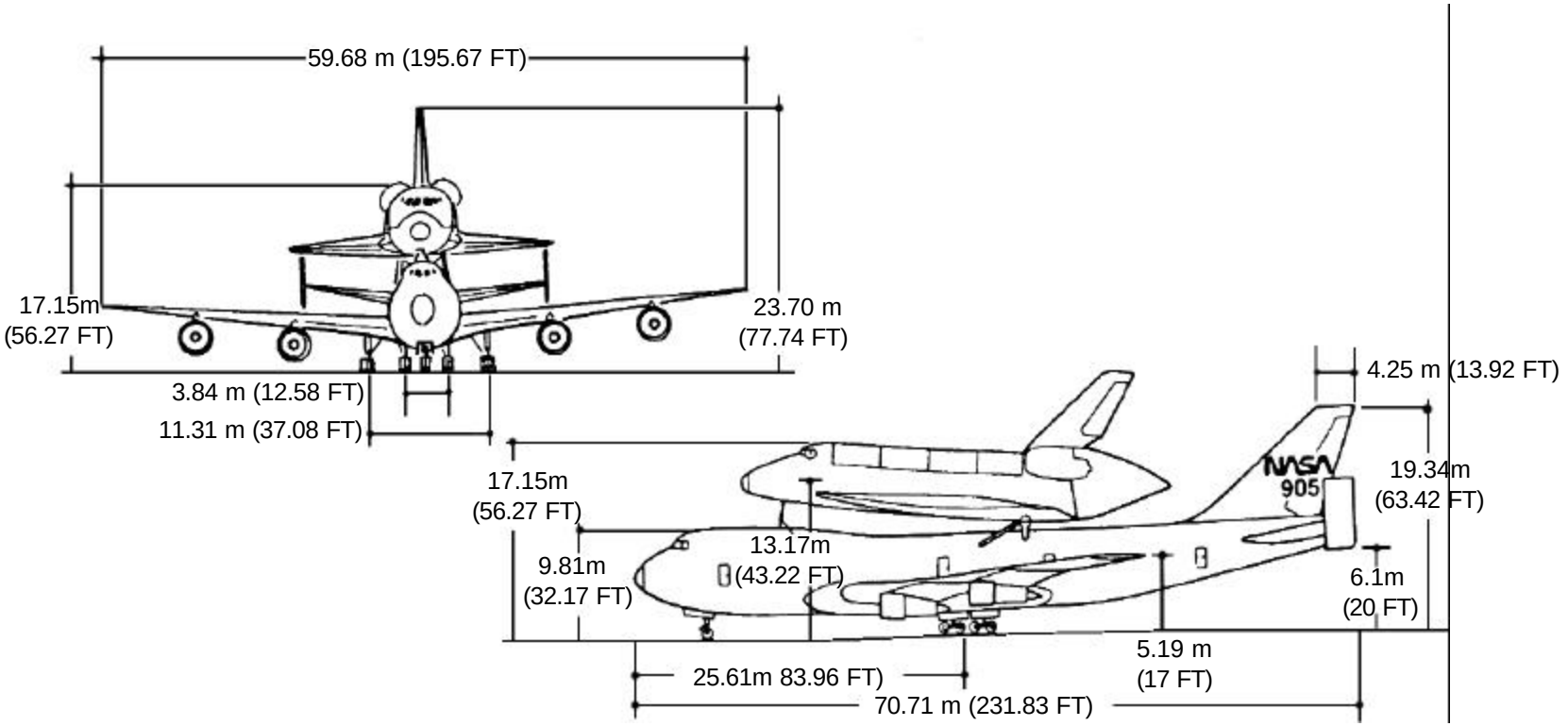
CONTROL CABIN/LOUNGE FLOOR
LEVEL TO GROUND 5.59m (18.33 FT)



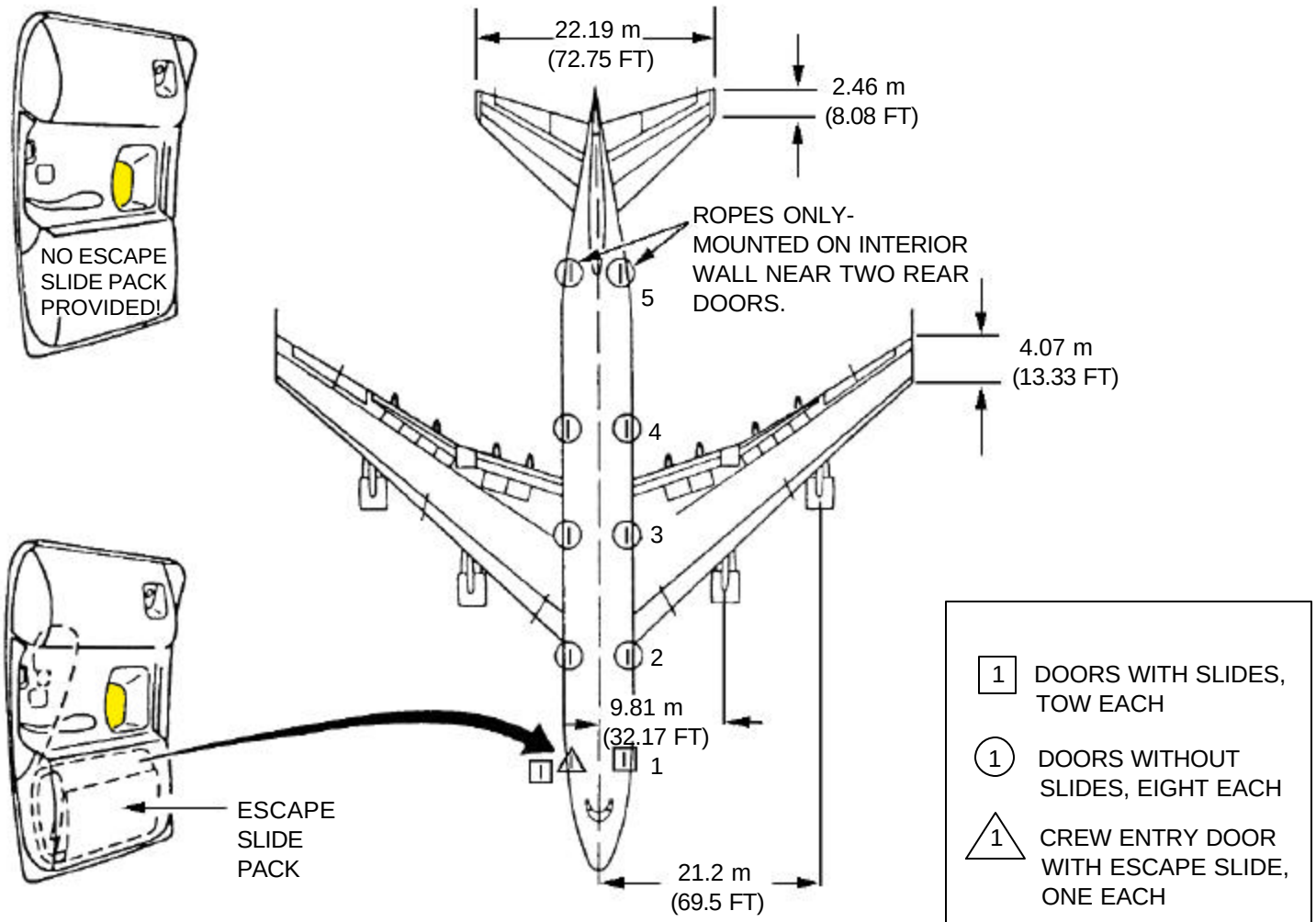
CREW DOOR HANDLE
6.2 m (20.33)

CREW ENTRY HANDLE
3.9 m (13 FT)

PASSENGER CABIN FLOOR
LEVEL TO GROUND 3m (9.83 FT)



ORBITER CARRIER DIMENSIONS-Continued

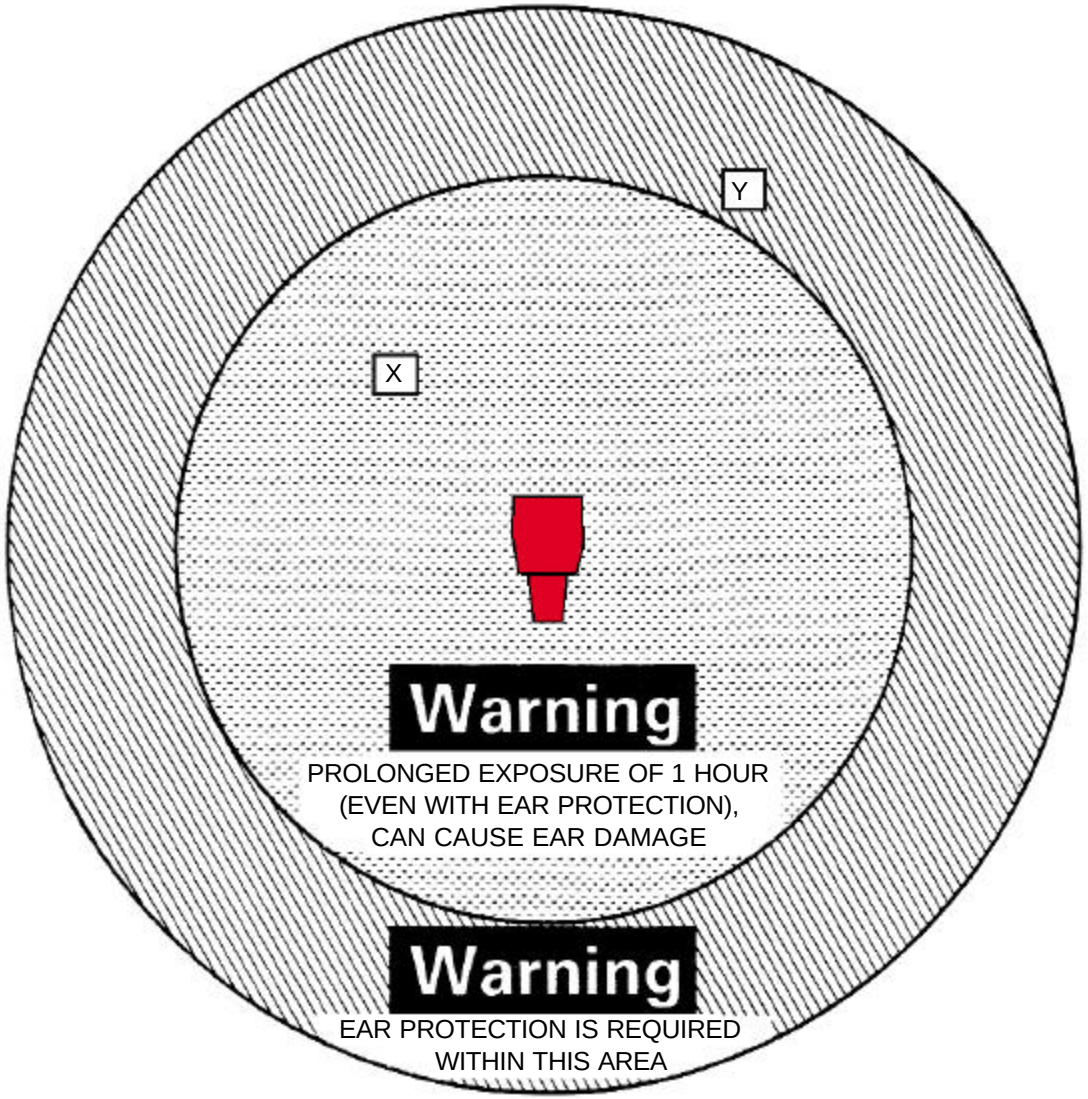


ORBITER CARRIER HAZARDS

Jet Engine Noise Hazard Areas

NOTE:
Shuttle carrier and Orbiter are mated.

SCA POWER SETTING	RADIUS X m (FT)	RADIUS Y m (FT)
GROUND IDLE	22.88 (75)	30.5 (100)
BREAKAWAY THRUST (N_1 -1800 RPM)	30.5 (100)	45.75 (150)
TAKEOFF THRUST	30.5 (100)	61 (200)



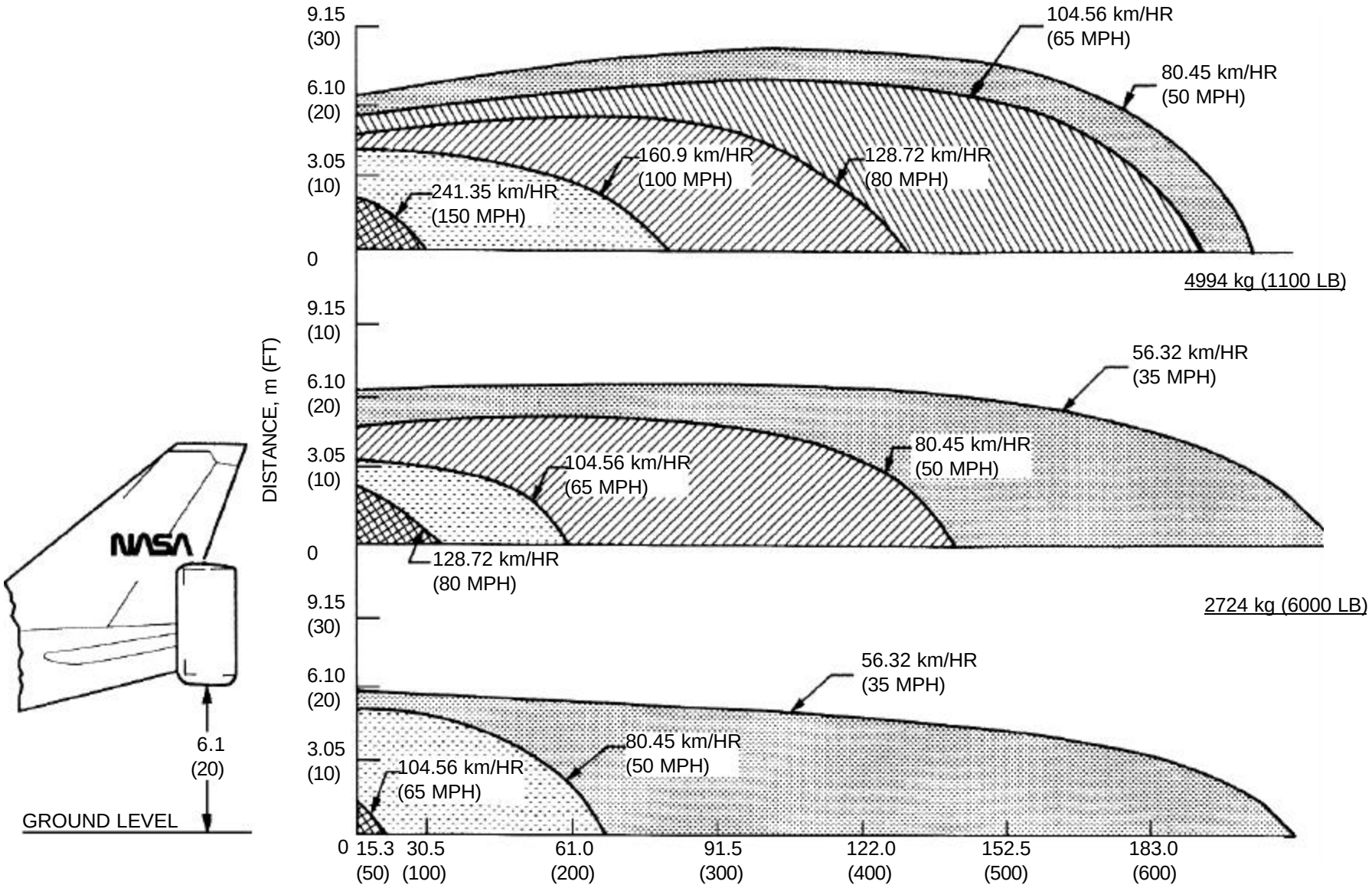
ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Wake/Velocity

Distance: meters (FEET)
Weight: kilograms (POUNDS (LB))
Speed: kilometers/Hour (Miles Per Hour)

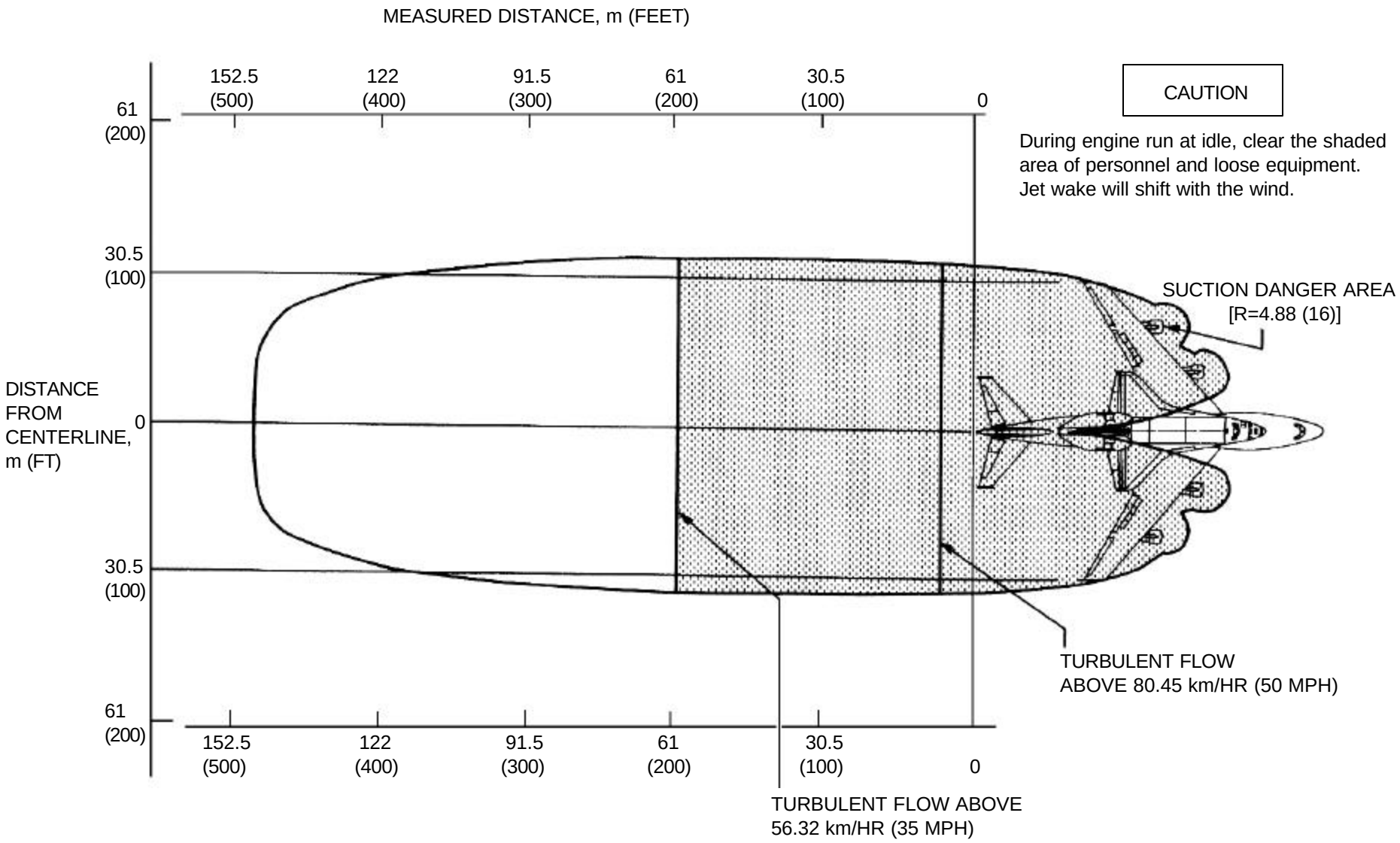
THRUST

TAKEOFF



ORBITER CARRIER HAZARDS-Continued

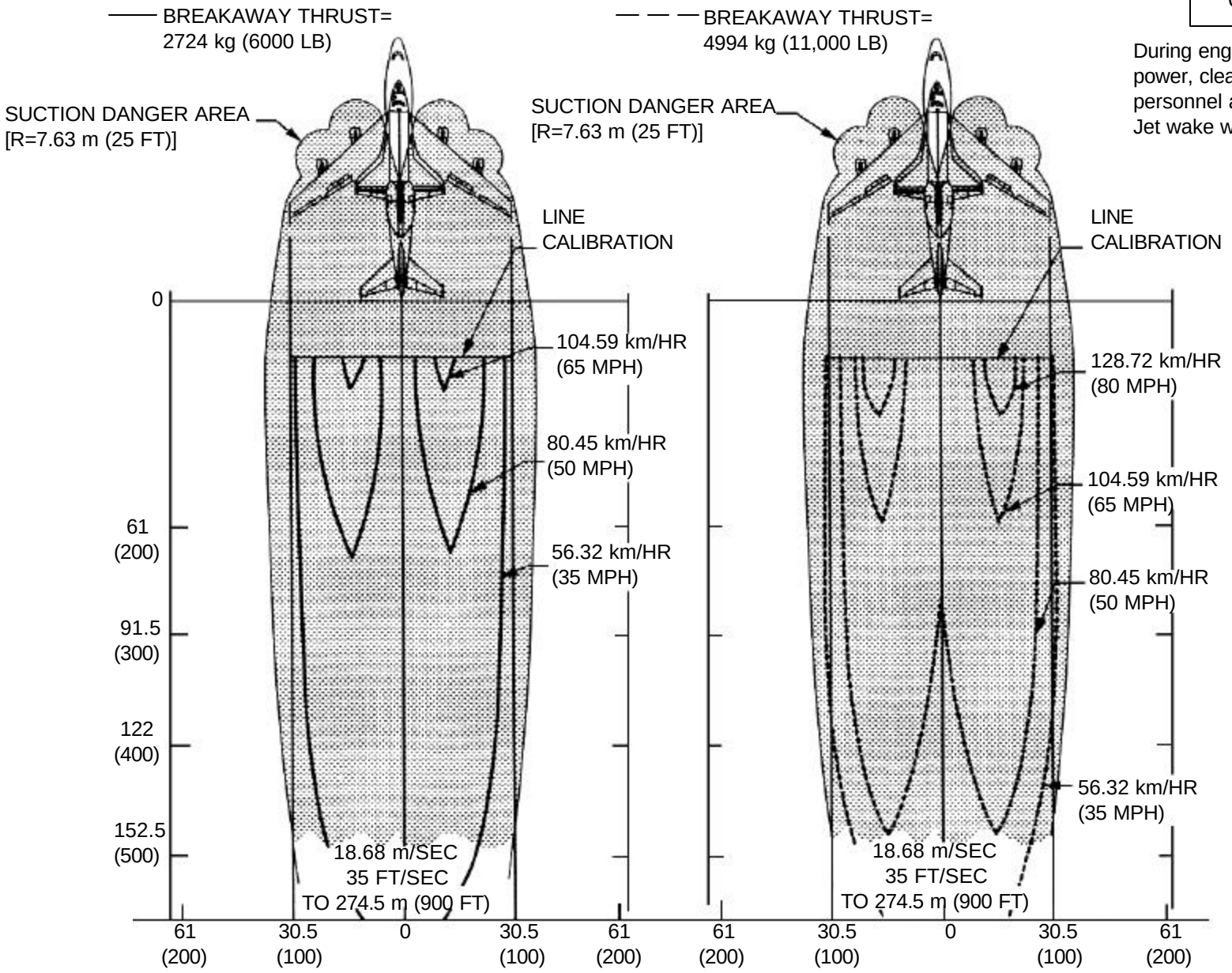
Jet Engine Exhaust Velocity - Idle Thrust



ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity - Breakaway Thrust

MEASURED DISTANCE, m (FT)



DISTANCE FROM CENTERLINE, m (FT)

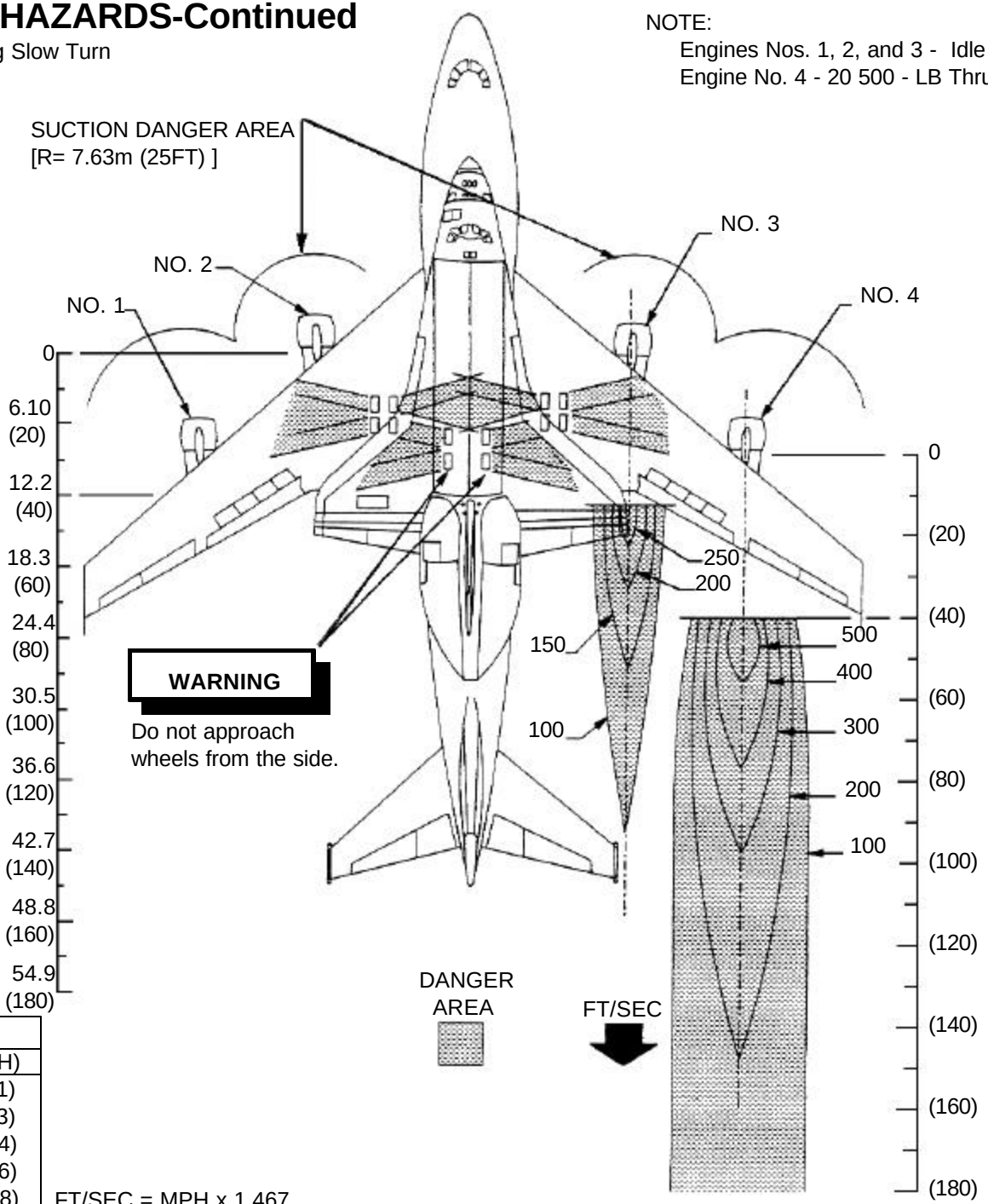
CAUTION

During engine run at breakaway power, clear the shaded area of personnel and loose equipment. Jet wake will shift with the wind.

ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity During Slow Turn

NOTE:
Engines Nos. 1, 2, and 3 - Idle Thrust
Engine No. 4 - 20 500 - LB Thrust



EXHAUST VELOCITY			
m/SEC	(FT/SEC)	km/HR	(MPH)
152.4	(500)	548.7	(431)
121.9	(400)	439.6	(273)
91.4	(300)	328.2	(204)
61.0	(200)	218.8	(136)
30.5	(100)	109.4	(68)

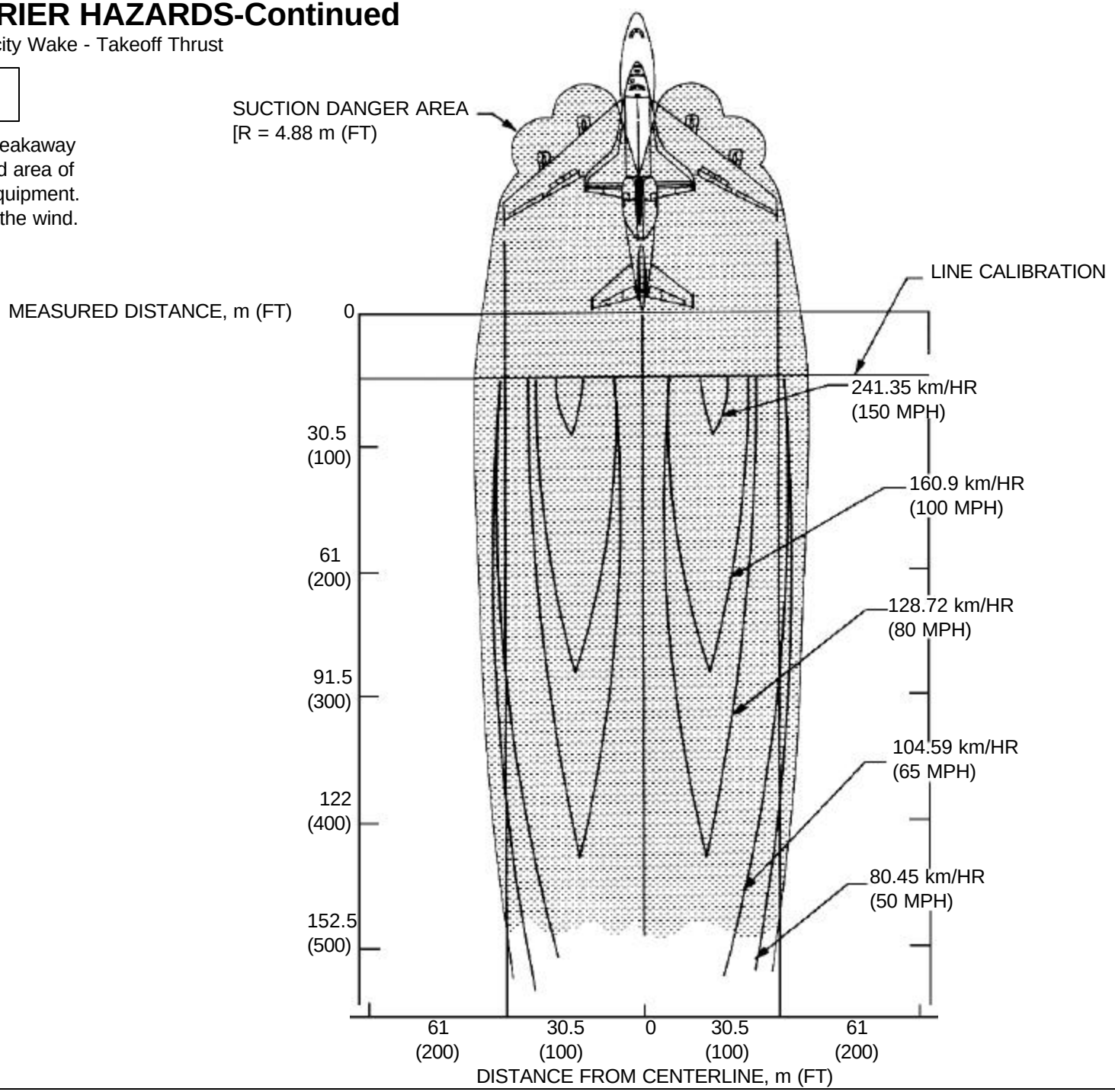
FT/SEC = MPH x 1.467

ORBITER CARRIER HAZARDS-Continued

Jet Engine Exhaust Velocity Wake - Takeoff Thrust

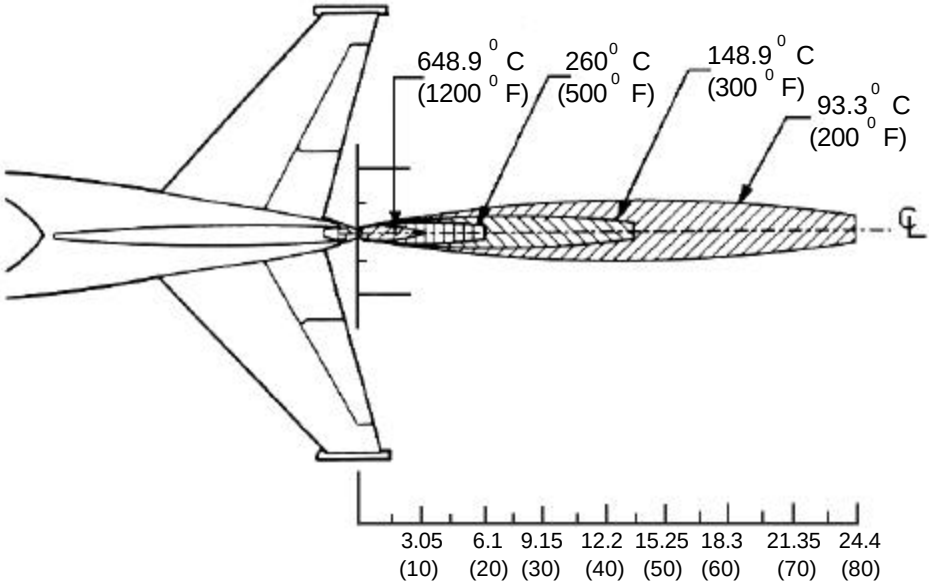
CAUTION

During engine run at breakaway power, clear the shaded area of personnel and loose equipment. Jet wake will shift with the wind.

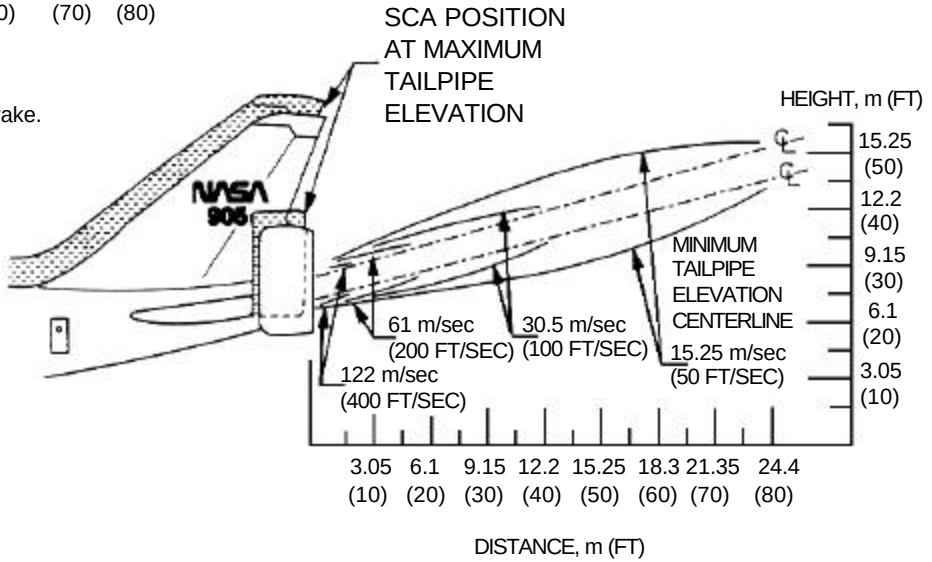


ORBITER CARRIER HAZARDS-Continued

Orbiter Carrier APU Exhaust Velocity/Wake



(h) SCA APU exhaust temperature/wake.



SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
SPAAT/Fire Drill II
35 Foot Ladder

NOTE:
Besides the flight crew on the flightdeck, approximately nine (9) personnel are located in the forward main deck.

AIRCRAFT ENTRY

1. NORMAL/EMERGENCY ENTRY

a. Pull entry door handles from recess position and rotate 180 degress clockwise for entry doors located on far left side and counter-clockwise for entry doors on right side.

NOTE:
All eleven entry doors open outward except crew entry door which slides aft.

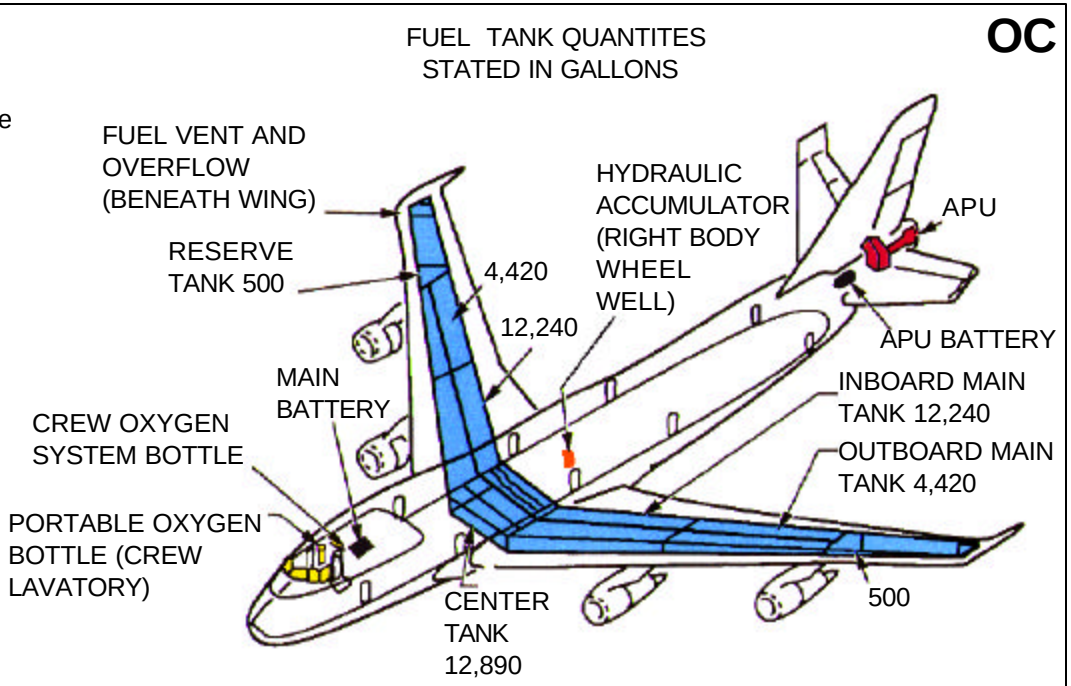
b. Press release button on crew escape hatch, located top forward center of crew compart-ment,and rotate escape hatch 180 degrees clockwise. Push escape handle inward.

c. Pull handle, located on crew door, and rotate 180 degrees counterclockwise. Push door inward until slide tracks are engaged, then slide door aft.

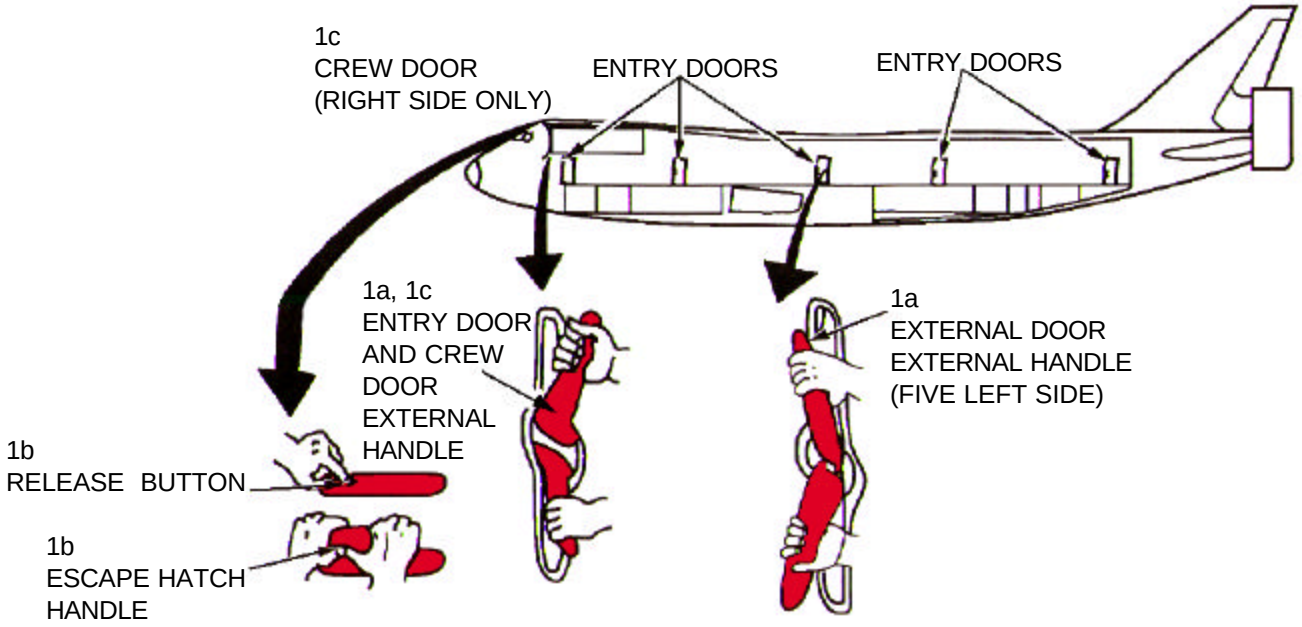
NOTE:
Only the two forward entry doors contain emergency escape chutes and are deployed only from inside the aircraft. Opening either door from the outside disengages the emergency evacuation system and the escape slide will not deploy. The other doors are blocked.

2. CUT-IN

a. Cut areas along the window lines as a last resort.



NOTE:
2 inch band of contrasting color around all doors and hatches that are operable from outside of the aircraft.



ENGINE SHUTDOWN AND AIRCREW EXTRACTION

1. EMERGENCY SHUTDOWN

a. Pull emergency fire T-handle, located on pilot's overhead panel.

b. Place battery switch, located on flight engineer's center panel, to OFF position.

c. Pull APU fire shutdown T-handle, located on flight engineer's upper left panel.

2. NORMAL SHUTDOWN

a. Retard throttles, located on pilot's center console, to IDLE position.

b. Place engine start levers, located on pilot's center console, to CUTOFF position.

NOTE:

If engines fail to shutdown, pull emergency fire T-handle, located on pilot's overhead panel.

c. Place battery switch, located on flight engineer's center panel, to OFF position.

d. Place APU switch, located on flight engineer's upper left panel, to STOP position.

NOTE:

If APU fails to shutdown, pull emergency T-handle located on flight engineer's overhead panel.

3. AIRCREW EXTRACTION

a. Unlatch lap belts and remove shoulder harness from crewmembers.

b. Depress control handles and rotate flight engineer's seat from left to right.

c. Passenger seats are equipped with lap belts only.